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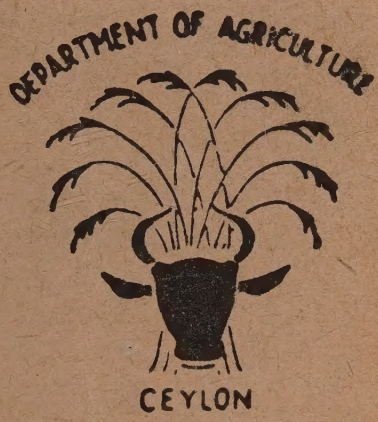

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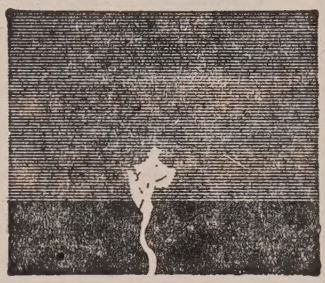

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EDITORIAL

Potentialities for Cashew

JUDGING by recent trends in the world trade in Cashew, there is every indication that the demand will continue to increase, particularly in view of its introduction to a number of new markets. Exports from the producing countries in 1960, have been 140,000 tons as against 82,000 tons in 1956, and the principal exporters of unprocessed nuts are Mozambique and Tanganyika. India is the chief exporter of processed cashew. Strangely enough, India is also the largest importer of unprocessed cashew, and the greater portion of the imports is for re-export, in the processed form, mainly to the United States of America which is the leading consumer of the product. Yearly imports of cashew into the U. S. A. in recent times have been valued at over 25 million dollars.

As is well known, the kernel of the cashew is the principal product obtained from the tree. Cashew kernels are used either in the fresh or the roasted form mainly as a dessert nut, and to a smaller extent in confectionery. Extraction of the kernels, is not a very attractive proposition, chiefly due to the occurrence of an irritating oil in the shell. However, as processing of cashew by roasting and shelling the nuts is carried out in India, other producing countries have found it convenient to ship their produce to India for processing.

Apart from the kernels, the oil obtained from the shell is also commercially important as it is used in the manufacture of resin and plastic. The United Kingdom, U. S. A., Japan and Australia are the principal importers of cashew nut oil and the main supplier is India. However, it has been estimated that oil is extracted only from about one-third the total quantity of nuts processed annually in India.

In Ceylon, cashew cultivation has not been hitherto carried out on systematic lines and most of the existing trees, particularly in the Batticaloa district, are from self-sown seed. The healthy growth and profuse production of the majority of trees found in various parts of the country indicate that cashew is not very exacting in its demands. It thrives well on soils ranging from hard cabok to almost barren sands. Organised cashew cultivation, therefore, appears to be a very attractive proposition, particularly in the extensive sandy tracts of the Batticaloa, Trincomalee, Puttalam and Mannar districts, which have an otherwise poor agricultural potential.

A particularly commendable feature in regard to cashew cultivation is that the establishment of plantations does not involve the investment of heavy capital. Once planted with the rains, cashew plants require very little attention. Therefore, cashew plantations can be established by clearing only the strips needed for the actual planting of seedlings. The only attention that will be necessary is the filling of vacancies, the control of highly competitive weeds and occasional hand-watering during the period of drought in the first year. Once the trees are about 4 years old and beyond the reach of goats, goat rearing can be undertaken on the plantations taking advantage of the shrub growth in-between the cashew trees. Cashew trees flower in about 5 years time and economic crops can be gathered from the 6th year onwards. The economic life of a cashew tree is about 40 years.

With a view to promoting the planting of cashew, the Ministry of Agriculture, Land, Irrigation and Power, has formulated a scheme to provide financial assistance to peasants and middle class persons, who will certainly need such aid till their plantations come into production. Its cultivation is also commended for the serious consideration of those on the look-out for new avenues of productive investment.

THE IMPORTANCE OF LEAF AREA AS A DETERMINANT OF YIELD IN PASTURES

R. R. Appadurai

(Department of Agriculture, University of Ceylon)

INTRODUCTION

It is seldom realized that nearly 95 per cent of the dry matter of plants is derived largely through the photosynthetic activity of their leaves, and that mineral nutrients obtained from the soil contribute directly, only to the remaining 5 per cent. Donald (1956) expressed the same idea, when after studying the effect of plant competition in pastures, he stated that if water and nutrients were in adequate supply, the ceiling yield would be determined by competition for light. Stated more simply, it means that the ultimate capacity for dry matter production depends on the degree to which plants can utilize the incoming light energy. The total amount of light energy available is the product of light intensity and light duration. The extent to which this light energy is utilized will, therefore, depend on the area of leaf displayed for light interception.

CONCEPT OF LEAF AREA INDEX

The work of Watson (1947, 1952) was the first real advance leading to a clearer appreciation of this phenomenon. He claimed that variation in yield can be attributed mainly to changes in leaf area which can operate directly by altering the photosynthetic area and indirectly by changing the net assimilation rate. In advancing the concept of leaf area index he wrote as follows : " A comparison of the leaf area per plant of different species, is of little interest, for these must be highly dependent on the spacing of the plants, which varied in accordance with normal agricultural practice. The measure of leaf area which is relevant to the comparison of agricultural yields, that is, of the weights of different crops per unit area of land, is the leaf area per unit area of land, which it is proposed to call the leaf area index. " Defined in this form, the concept of leaf area index, provides a

measure of the whole crop rather than of individual plants, an important distinction, which should be borne in mind, when undertaking studies on the physiology of field crops.

RELATIONSHIP BETWEEN LEAF AREA AND CROP YIELD

It seems reasonable to suggest at this stage, that other things being equal, the opportunity for increasing agricultural production, in general, lies in increasing the total annual photosynthesis per unit area of crop. This would depend on (1) leaf area (2) rate of photosynthesis and the length of the growing period (leaf efficiency). A measure of leaf efficiency is provided by the rate of increase of dry matter per unit area of leaf which is referred to as the net assimilation rate. Watson (1956) showed conclusively in his Rothamsted experiments on wheat, barley, sugar beet and potato, that of these factors, the main factor which influenced crop yield was leaf area. Increase in leaf area was accompanied by an increase in yield. The relationship between leaf area and dry weight yield was linear, except in the higher range, when owing to the mutual shading of the lower leaves, the net assimilation rate was depressed. Crop growth rate, therefore, increases slowly with increase of leaf area till it reaches a maximum and then falls. Thus it can be seen that leaf area has a direct bearing on dry weight yield. Cultural practices that are designed to increase agricultural yield, do so mainly by influencing leaf growth. Fertilizer applications and manurial practices also do the same.

LEAF AREA AND PASTURE GROWTH

Though the importance of leaf area in crop production has been stressed for some time, only recently has it been applied to the study of pasture growth. The reasons warranting the estimation of leaf area in pasture communities, are obvious. Leaf growth, for example, directly governs the value of the sward for livestock. Further a number of species occur in close association in a sward, resulting in quite different distributions of foliage displayed for the interception of the incoming light energy. Frequent or intermittent defoliation of the sward either by the mower or by the grazing animal constantly alters the light environment in a sward.

Very few studies, however, have in fact been reported. Donald (1956), and Davidson and Philip (1956), both used the concept of leaf area index to correlate light status within the pasture and pasture growth. But perhaps the most significant contribution to an understanding of the relationship between leaf area and pasture yields was

the work by Brougham (1956) who reported the results of his investigations into the effect of intensity of defoliation on the regrowth of pasture. He reported that the height of defoliation markedly influenced the rate of regrowth. The stage at which 95 per cent of the incident light energy was intercepted and hence a maximum rate of regrowth attained, corresponded to a leaf area index of 5, and following defoliation to a height of 5 inches this was achieved approximately 4 days after cutting, whereas regrowth did not reach a maximum rate until 16 and 24 days following defoliation in pasture defoliated to 3 inches and 1 inch respectively. Beyond this point the rate of increase in leaf area and the increment in dry matter was maintained at a maximum rate. From the same experiment he calculated leaf efficiency indices for each sampling date as average daily herbage dry matter increment per area of leaf, and stated that the more intense the defoliation the lower was the initial leaf efficiency. However, a higher maximum leaf efficiency was obtained after intense defoliation.

Appadurai (1961) in a series of experiments conducted at Wye in England between 1958—61 to study the influence of a close (1 inch above ground level) versus a lax (2½ to 3 inches above ground level) defoliation on the performance of a perennial rye grass/white clover sward, observed that close defoliation particularly in the early part of the season, gave considerably higher yields of herbage dry matter than lax defoliation. This did not hold true for the later part of the season. Close cutting increased herbage yields significantly by increasing the leaf area index of the sward at a time when environmental conditions were optimum for increased leaf efficiency. The results of an experiment conducted in the spring of 1961 are shown in Table I. Close cutting significantly outyielded lax cutting in total herbage production during the experimental period. The rate of increase of leaf area under close cutting followed the same pattern as the rate of increase of total herbage. The decline in leaf area index of the mixed herbage under lax cutting was attributed to a decline in the leaf area index of the grass component, following ear emergence. This resulted in reduced total yields under lax cutting. A highly significant regression of leaf area on herbage yield was obtained under close cutting confirming the linear relationship between leaf area and herbage yield referred to earlier (Figure 1). Unfortunately, no significant regression of leaf area on herbage yield could be established under lax cutting, in this experiment, though it was confirmed in earlier investigations. It seems probable that during certain developmental phases of growth, as for example ear emergence following lax cutting under the conditions of this experiment, the relationship may not hold true.

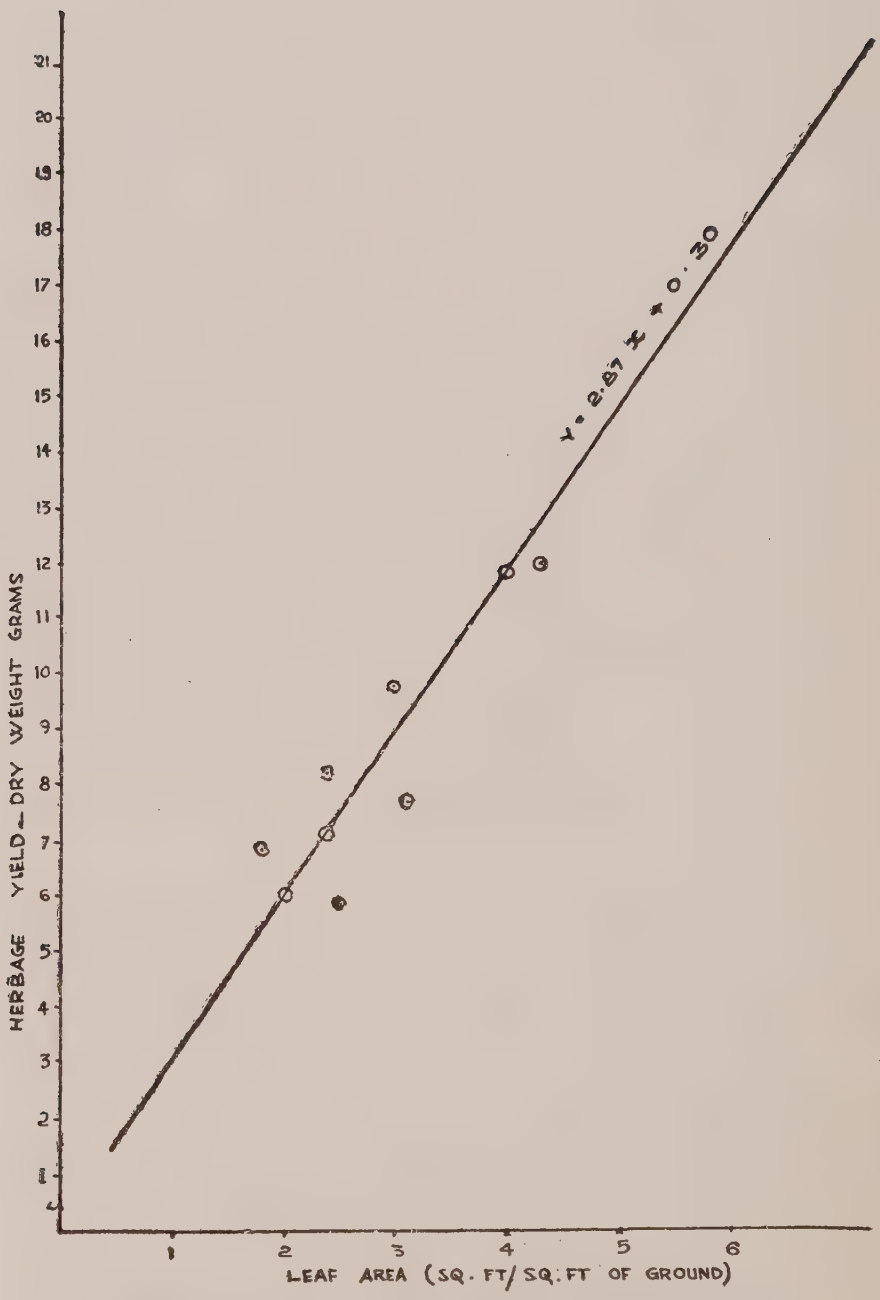

Fig. 1.—Relationship between Leaf Area and Herbage Yield under close cutting.

TABLE 1

Changes in Leaf Area Index and Mean Dry Matter Yields of Mixed Herbage, Grass, and Clover estimated from ½ sq. ft. Samples of Herbage.

	Days of growth								
	4	*8*	*12*	*16*	*20*	*24*	*28*	*32*	*36*
Leaf area index									
(1) *Mixed herbage*									
Lax cut	5·3	4·1	3·8	4·1	4·0	3·7	3·6	4·3	3·4
Close cut	1·8	2·5	2·4	2·4	3·1	3·0	4·3	5·4	5·6
(2) *Grass*									
Lax cut	4·6	3·2	2·9	2·6	3·1	2·6	2·5	2·6	1·9
Close cut	1·5	1·8	1·9	1·6	1·9	1·8	2·4	2·7	2·6
(3) *Clover*									
Lax cut	0·7	0·9	0·9	1·5	0·9	1·1	1·1	1·7	1·5
Close cut	0·3	0·7	0·5	0·8	1·2	1·2	1·9	2·7	3·0
Yields–dry wt.g.									
(1) *Mixed herbage*									
Lax cut	12·53	10·95	11·48	12·58	12·87	13·44	13·60	13·62	14·00
Close cut	6·80	5·75	7·04	8·14	7·56	9·69	11·91	16·17	16·93
(2) *Grass*									
Lax cut	10·77	9·11	9·25	9·14	10·81	10·70	10·75	9·58	9·63
Close cut	5·99	4·28	5·75	6·33	4·97	6·89	7·49	9·54	9·59
(3) *Clover*									
Lax cut	1·75	1·84	2·23	3·44	2·06	2·74	2·84	4·04	4·36
Close cut	0·81	1·47	1·45	1·80	2·58	2·80	4·41	6·62	7·33

Each value is the mean of 3 replicates

Leaf efficiency indices dy/dt/A (where dy/dt is the rate of increase of herbage yield and A is the total leaf area in sq. ft. per sq. ft. of ground) for each sampling date were obtained from values of dy/dt and A taken from smoothed curves of herbage yield and leaf area plotted against time. These smoothed curves give better estimates of yield and increment relationships than the raw data, and are devoid of the measurement errors that normally occur in such computations. Smoothed curves of herbage yield plotted against time are shown in Figure 2. Table 2 shows the leaf efficiency indices calculated for each sampling date.

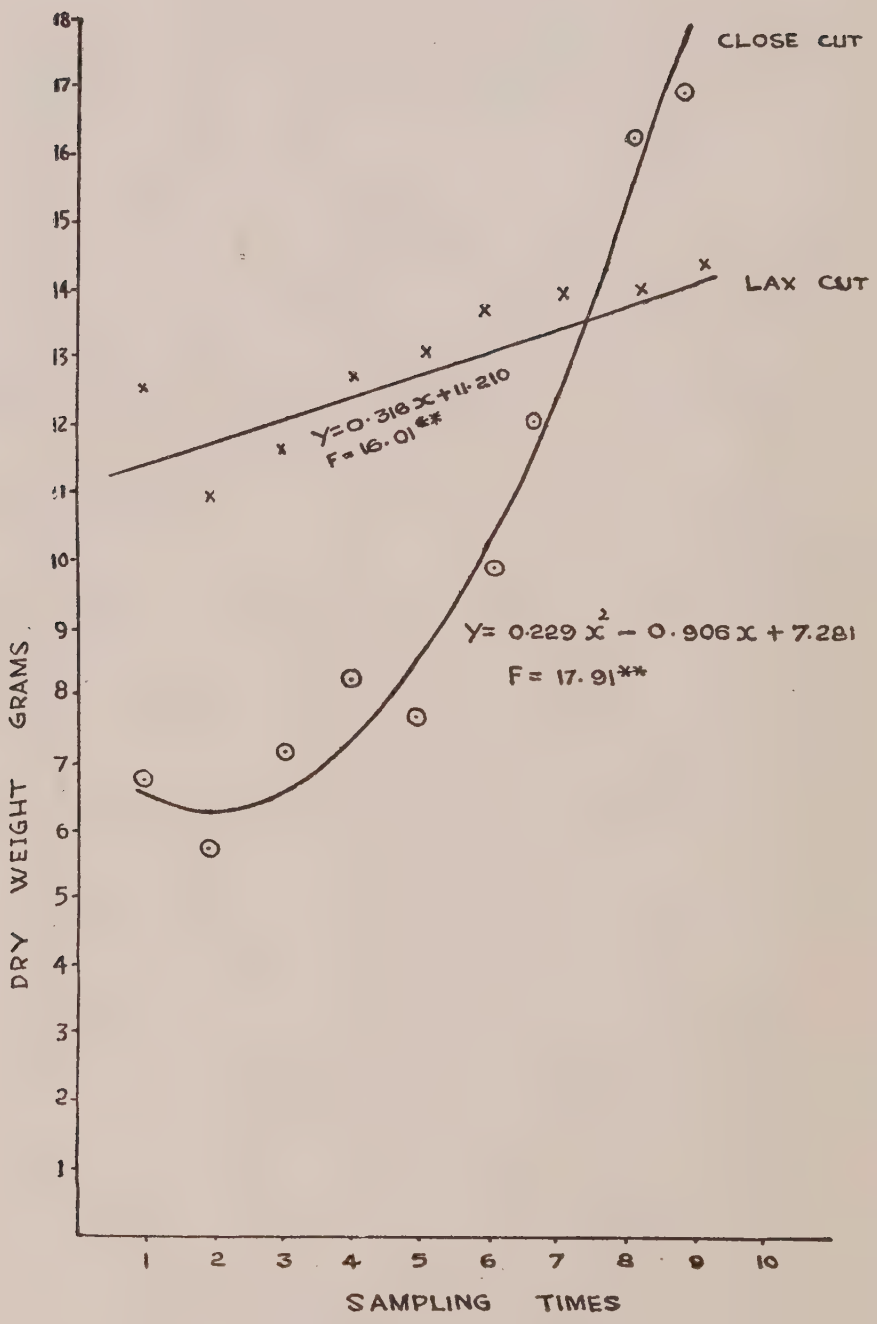

Fig. 2.—Smoothed Curves of Herbage Yield

TABLE 2

Leaf Efficiency Indices

	Days of growth								
	4	*8*	*12*	*16*	*20*	*24*	*28*	*32*	*36*
Lax cut dy/dt = 0·316	0·069	0·071	0·073	0·075	0·078	0·080	0·083	0·086	0·089
Close cut dy/dt = 0·458X —0·906	–0·210	0·004	0·204	0·357	0·461	0·521	0·550	0·558	0·553

Close cutting resulted in a higher maximum leaf efficiency compared to lax cutting, but the initial efficiency was lower. The higher leaf efficiency under close cutting may be attributed partly, to the fact that the foliage of close cut plants were at the proper age.

In the above studies no attempt was made to relate the leaf area index of the sward under the two cutting treatments to light interception. The work of Brougham (1957) and more recently Black (1959), however, suggests that the rate of growth of an undefoliated pasture is exponential till it attains the 'critical leaf area index', i.e., the point of complete light interception. During this phase, production falls short of that which the incoming light energy could sustain, since the leaf area is insufficient to utilize all the incoming light. Once the 'critical leaf area index' has been attained, any further increase in leaf area can no longer result in an increase in light absorption, and hence the relative growth rate falls. It is clear, therefore, that the aim of pasture management should be to attain as quickly as possible the optimum leaf area index, and maintain the pasture at this level. Such a form of management would ensure the maximum of herbage yields from a given unit of land. The concept of leaf area index, is thus of more than theoretical interest in studies of pasture production, and warrants further investigation especially under the high light intensities of the tropics.

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THE MEASUREMENT OF LEAF AREA IN PASTURE PLANTS

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The significance of leaf area in pasture growth, and its importance as a determinant of herbage yield, has been described and discussed in the preceding article. Workers who have attempted to use the concept of leaf area index in studies of pasture production have, however, experienced considerable difficulty in measuring leaf area in pasture communities. This is largely because of the fact, that even in a relatively small sample of herbage (e.g., herbage from a ½ sq. ft. of ground) thousands of leaves are involved, and a direct estimate involving every single leaf cannot easily be made. Consequently, it has been customary to use a sub-sample of representative leaves, measure their leaf area, and then relate the weight per unit area of the sub-sample to the dry weight of the sample, to determine total leaf area. Very often in pasture communities, the problem is complicated further by the fact that different species grow in association, and the process of sub-sampling for estimation of leaf area has to be repeated for each individual component of the pasture. This involves among other things hand separation of samples of herbage from a mixed sward into their component species. Finally, an estimate of weight per unit area of leaf has to be obtained for each sampling date, using a separate sub-sample each time, since this co-efficient shows marked variations through the growing season. Table 1 shows a comparison of the mean weights per unit area of grass and clover leaves, taken at random at different times of the season on a pasture of perennial rye grass and white clover. (Appadurai 1961). The weights per unit area of both grass and clover leaves showed marked seasonal variations. Further, the mean weight per unit area of grass leaf was significantly higher than that of the clover leaf.

TABLE I

Comparison of the Weights per Unit Area of Grass and Clover Leaf at different times of the Season

	5. 8.60	8. 9.60	26. 5.61	3. 6.61	11. 6.61	23. 6.61	*Mean*
Grass :							
Leaf area (sq. cm.) ..	82·4	85·1	41·1	64·7	58·7	62·3	65·7
Leaf weight (g) ..	0·321	0·249	0·127	0·223	0·222	0·239	0·230
Wt/area (g/sq. cm.) ..	0·0038	0·0029	0·0030	0·0034	0·0037	0·0038	0·0034
Clover :							
Leaf area (sq. cm.) ..	42·8	34·8	37·8	34·3	31·1	44·2	37·5
Leaf weight (g) ..	0·128	0·084	0·092	0·094	0·093	0·145	0·106
Wt/area (g/sq. cm.) ..	0·0029	0·0024	0·0024	0·0027	0·0029	0·0032	0·0027

These observations emphasize the need for regular sub-sampling in order to get a fresh estimate of weight per unit area of leaf at each sampling date, and confirm the observation made earlier, that one of the main factors contributing to the difficulties of leaf area measurement in pasture communities, is the necessity for regular and detailed sub-sampling.

TECHNIQUE OF LEAF AREA MEASUREMENT

SEVERAL methods of estimating leaf area both in crops and in pastures have been reported in recent years, most of which are indirect estimates made from certain morphological attributes of leaves. A few of these methods that have been used by workers in various parts of the world are listed below. Brougham (1956) estimated the leaf area of a rye grass/clover pasture subjected to three heights of defoliation, from samples of herbage taken from 1 sq. ft. quadrats at 4 day intervals during a recovery period of 32 days. He measured the mean width of central 100 m.m. sections of forty rye grass leaves, oven-dried the sections, and then calculated the weight per unit area. From the dry weight of the bulk sample and the weight per unit area of the sub-sample, he estimated total leaf area. He determined the area of clover leaf similarly using disks of known diameter taken from clover leaves. Neales (1956) described a method of measurement of leaf area in barley leaves in which he calculated leaf area from measurements of leaf length and breadth, using a correction factor leaf index (k) based on the ratio :

$$\frac{\text{Computed area } (l \times b)}{\text{Actual area } (A)}$$

Langar (1956) and Kemp (1960), both described methods of estimating leaf area in grasses based on measurements of length and

breadth of leaves. Even in these methods, a technique of correlating the leaf area of a known sub-sample to that of the main sample is implicit, owing to the average size of herbage samples.

In recent years several devices which could deal with slightly larger samples, and which could at the same time simplify the actual measurements have been developed. Maggs (1956) described an instrument which estimated photo-electrically the area of 100 — 400 sq. cm. of detached leaves. More recently Jenkins (1959) described an air flow planimeter which measured the areas of detached leaves quickly and reasonably accurately. Both these devices are improvements on the methods described earlier, but are still limited by the fact that they involve sub-sampling, and further individual handling of every single leaf of the sub-sample, similar to the other methods.

THE USE OF THE PLANIMETER IN MEASURING LEAF AREA

Appadurai (1961) observed that the use of the planimeter was an effective method of measuring leaf area in pasture plants. The error involved is of the order of 2 per cent (which is lower than most other methods), and the method itself is the simplest, so long as methods which eliminate the need to sub-sample are not available. In experiments conducted at Wye in England, on a pasture of perennial rye grass and white clover, the following procedure for sampling and measuring leaf area was adopted.

METHOD OF SAMPLING

Leaf area determinations were made from samples of herbage taken from a ½ sq. ft. of ground. At regular intervals herbage from a ½ sq. ft. of ground was cut to ground level and removed to the laboratory for leaf area determinations. In order to obtain suitable samples a grid, divided into ½ sq. ft. areas was constructed. At each sampling date, the grid was placed over the sward and the appropriate predetermined area was harvested. No area was sampled more than once.

METHOD OF ESTIMATING LEAF AREA

In the laboratory the samples of herbage from the ½ sq. ft. quadrats were first separated into grass and clover. The individual components were again separated into leaf and stem. About 40 grass leaves and 10 clover leaves were then picked at random and laid out with their flat surface on a photosensitive dyaline paper, held firmly in a

frame, and covered with a sheet of glass. The paper was then exposed either to sunlight or strong artificial light which desensitized the uncovered portions of the paper. The covered portions on mopping with a sponge dipped in Unax developing solution, yielded well defined black line prints of the grass and clover leaves. The sub-samples of grass and clover leaves were then oven dried in separate containers at 90°C for 24 hours, while their areas were determined from the prints by the use of a planimeter. Thus the weights per unit area of grass leaf and clover leaf were obtained. The remainder of the grass and clover leaves from the quadrat were oven dried separately to determine their individual dry weights. From these values it was possible to calculate the total leaf area of grass and clover in the sample, and also the leaf area index of the mixed herbage.

The above method of estimating leaf area, developed for use in a mixed sward of grass and clover, would be considerably simplified if applied to a pure grass sward. The method eliminates the use of expensive equipment, is relatively simple, and reasonably accurate.

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STUDIES ON THE GRAZING HABITS OF CATTLE IN RELATION TO THE SEASONAL UTILIZATION OF DRY ZONE PASTURES*

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Although adequate information on the grazing behaviour of cattle is available in the temperate regions, few such studies have been made under tropical conditions.

Payne *et al.* (i) studying the grazing habits of Friesian cows under tropical conditions in Fiji found that the total grazing time was reduced in hot weather due to the diminution in the length of daytime grazing. In their studies, they observed that 67 per cent of the total grazing time took place at night. These workers therefore concluded that the grazing habits of cattle in the tropics were radically different from those in the temperate zones.

At the Coconut Research Institute, Gunasekera (2) made observations on the time spent in grazing by indigenous Sinhala cattle tethered to coconut palms. He observed that on the average these cows grazed 10.3 hr. and that the bulk of the grazing occurred during the hottest part of the day. Several investigations have been reported where the grazing behaviour studies have been successfully used in the solution of grazing management problems. (3.4). Hughes and Harker (4) showed how behaviour studies can be used in the improvement of animal weighing methods, when cattle are at grazing.

In the tropics, there is little information available on the precise way in which pastures should be managed in order to utilise the sward

* Based on a paper read at the Sixteenth Annual Session of the Ceylon Association for the Advancement of Science, 26th November, 1960.

nutrients to the optimum in a system of intensive grassland management. The lack of precise information is no doubt due to the absence of reliable data on the grazing habits of cattle.

The main objective of this investigation which was initiated in January, 1959, was to study the grazing habits of the Sahiwal breed of dairy cattle with particular reference to the seasonal utilization of pastures in the dry zone of Ceylon and thence, to make tenative suggestions for the improvement of grazing management.

EXPERIMENTAL

Cattle. Four, two and half year old Sahiwal heifers of similar weight were selected for these observations. All sixteen observations were carried out using the same group of animals. The animals used were familar to being handled in experimental plots without causing any disturbance.

Pasture. Two one-acre plots of *Brachiaria brizantha,* one of which contained three large trees for shelter, were chosen for paddocks. Although there was always an abundance of forage, its quality varied from season to season.

Pasture Conditions. The pattern of herbage production in the dry zone assumes a bimodal form, coincident with the rainfall (5), In pastures, there is a flush period from October to November followed by a slower but steady vegetative growth in December and January. With the yala rains in April and May, there occurs a second growth period which is followed by a period of restricted growth in June and a final drying off of pastures with the advent of dry weather in July. A brief description of the pasture conditions during the experimental periods is shown in Table II.

Estimate of Pasture Yields. Estimates of pasture yields were made by cutting the herbage at ground level from 4 quadrats (3′ × 3′) at the time of cattle introduction. The samples were weighed green and a sub sample was hand separated into green and dry Brachiaria. A second sub sample was oven-dried for the determination of moisture and chemical analysis. The dry matter yields shown in Fig. I are not additive since they do not provide an estimate of production over the year.

Weather. Weather conditions varied widely during the trial. In order to avoid the effects of unusual climatic variations, much care

was taken to select a day during which the climatic conditions were typical for the month under observation. Table I gives briefly some of the details.

Observation Techniques. Observations were made for a 24-hr. period at monthly intervals. The animals had access to the pasture at least a day before the observations began. During moonless nights, a flash light was used to observe their activities in the dark. Recordings were made every minute throughout the 24 hr. period of the animals which were engaged in various activities. The activities were classified into—

(1) Grazing—time spent in grazing, gathering and selection of herbage.

(2) Idling—time spent in standing, walking, etc.

(3) Lying down—time spent in lying down.

In these observations, no attempt was made to record the time spent in ruminating.

DISCUSSION OF RESULTS

The time spent in various activities by cattle during single 24-hr. periods for sixteen observations are presented in Table II.

TABLE 1
Weather Data

Date	*Max. Temp. of*	*Min. Temp. of*	*Relative humidity at 8.30a.m.*	*Rainfall inches*	*Remarks*
24. 1.59	87·3	68·0	88	—	Warm and humid
22. 2.59	89·9	71·8	91	—	Warm day with bright sun shine, cool night
25. 3.59	98·0	72·0	86	—	Hot and humid, no breeze
23. 4.59	90·8	76·7	81	—	Warm, clear day
21. 5.59	87·9	75·9	80	—	Light shower at 11 a.m.
26. 6.59	85·9	73·9	84	—	Cool morning, cloudy with cool breeze from S. W.
21. 7.59	91·6	75·1	78	—	Warm, strong blowing from S. W.
18. 8.59	92·0	74·0	74	—	Strong blowing from S. W.
15. 9.59	92·3	74·4	70	—	Warm, with strong blowing from S. W.
17.10.59	95·2	71·5	86	·10	Warm and humid
16.11.59	84·2	70·2	95	·38	Thick mist in early morning, shower in early afternoon
17.12.59	85·1	68·0	93	·77	Cloudy, rain throughout the afternoon
13. 1.60	80·1	69·5	93	·07	Cloudy day, intermittent showers
19. 2.60	84·0	70·2	100	·56	Misty morning, with plenty of dew
29. 3.60	94·1	66·3	78	—	Warm with no breeze
29. 4.60	87·9	75·2	87	—	Warm and humid

TABLE II

Average Time spent per Heifer in various activities (Minutes) and Pasture Conditions

Month	*Grazing*	*Idling*	*Lying down*	*Conditions of the pasture*
January, 1959 ..	384	328	728	Grasses slightly matured
February, 1959 ..	482	236	722	Coarse growth, fair amount of dry material
March, 1959* ..	640	211	589	Almost dried pasture
April, 1959 ..	385	435	620	Grass a foot high, soft young flush
May, 1959* ..	354	519	567	Dense growth of grass, 18–24″ high
June, 1959 ..	449	317	674	Fair amount of green matter mostly old growth
July, 1959 ..	602	299	539	Pasture partially withered
August, 1959 ..	637	219	584	Almost dried up pasture
September, 1959	625	235	580	Mostly old growth, very little green matter
October, 1959* ..	520	365	555	Young growing pasture, 6″ high
November, 1959	463	446	531	Leafy pasture
December, 1959*	460	612	368	Leafy, dense growth of grass, 18″ to 24″ high
January, 1960 ..	494	444	502	Advanced stage of growth
February, 1960 ..	567	446	427	Fair amount of green material still evident
March, 1960 ..	716	166	558	Partially withered pasture.
April, 1960* ..	37–	520	546	Young foliage, 9″ to 12″ high
Average ..	510 (8·50 hr.)	362 (6·03 hr.)	568 (9·47 hr.)	

* Shade available.

The average time occupied in grazing was found to be 8.50 hr. per day and ranged from 5.90 hr. to 11.90 hr.

Although Larkin (6) and Payne *et al.* (1) found that weather was the major cause of variation affecting the grazing habits of cattle in tropical Queensland and in Fiji, these results appear to indicate that the condition of the pasture had a much greater effect than adverse climatic conditions and in fact, in all these observations, a major portion of the grazing was done during the hottest part of the day. (see Fig. 3).

It can be seen from a perusal of Table II and Fig. 1 that cattle on good pasture spent less time in grazing, but as the quantity and the quality of the pasture decreased, the grazing time also increased. The significant decrease in grazing time during October to January and once again during April to June reflects the better growing conditions due to adequate rainfall. The increase in grazing time in March, July, August and September may be attributed to the decrease in the quantity of pasture arising from severe drought conditions which prevail at this time of the year. In March, 1960, for instance, the animals spent about 100 per cent more time in grazing than in May, 1959.

The shorter time expended in grazing and idling and the increase in the time of lying down on good pastures also indicate that cattle were able to obtain their feed requirements with a smaller expenditure of energy in comparision to those grazing on poor quality pastures. The only exception was in December, when heavy rains increased the total idling time with a corresponding reduction in the time spent lying down.

The yield of dry Brachiaria is particularly high during periods of low herbage production (see Fig. 1). The average protein content of dry and green Brachiaria was 2.99 per cent (range 2.17 per cent to 3.75 per cent) and 6.92 per cent (range 3.96 per cent to 12.54 per cent) respectively. The high yield of green Brachiaria in the sward indicates an increase in herbage quality. It can be seen that the time spent in grazing appears to be related to the amount of green material present in the pasture. It was also observed that during dry weather, the cattle were very selective and spent considerable time in walking, gathering and selecting green material. It cannot be concluded that grazing is linked with a high content of crude protein or a low percentage of fibre or dry matter, although this seemed to be the case when animals showed a preference to graze the young and tender shoots of grasses.

It must be admitted that any improvement that will cause cattle to obtain their sustenance with a minimum of grazing will conserve the energy for milk and beef production. Energy expended in work, as a result of excess grazing is used at the expense of production, particularly when herbage is sparse and supplementary feeding is not the general practice. This emphasises the need that cattle, particularly the dairy cattle, should have access to better quality pastures during the day.

Periodicity of Grazing Habits. Grazing was largely done during the daylight hours whilst the nights were mainly devoted to lying down (see Fig. 2). Of the total grazing time, 75 per cent occurred during the day. During the night however, 6.75 hr. were spent in lying down. This represented 70 per cent of the total time devoted to this activity. All studies have shown that these habits can change in these respects, only under very adverse weather conditions.

To study the pattern of grazing behaviour, periodicity charts were constructed from data collected. An example of such grazing periodicity, as occurred on two pasture types in April, 1959, and March, 1960, is shown in Fig. 3.

The distribution of grazing time between the two pasture types was not indentical. In March, when quality herbage was sparse, there was

a marked increase in the grazing time, compared with better quality pasture in April and grazing was more or less continuous throughout the day.

Grazing usually commenced about 7.30 a.m. depending largely on weather conditions. When the herbage is wet with rain or dew, grazing was generally delayed. In the mornings the heifers grazed steadily, but not so intensively as in the afternoons and the grazing period ceased abruptly at sunset time. The relationship between the last daylight grazing period and the time of sunset is illustrated in Fig. 4.

The small amount of night grazing which varied from season to season did not follow a regular pattern.

Effect of Shade. Shade was made available to these animals in March, May, October, December, 1959, and April, 1960, and the time spent in the shade between 10 a.m. and 3 p.m. was recorded. The data relating to the average total time spent in the shade irrespective of the activities are presented in Table III. The provision of shade caused cattle to seek shelter during the hottest part of the day, when heat became uncomfortable. Due to heavy rains, throughout the afternoons in December, less use was made of the shade.

TABLE III
Time spent in the Shade between 10 a.m. and 3 p.m. (Minutes).

Date			*Shade*
25.3.59	..	..	123
21.5.59	..	..	126
17.10.59	..	..	155
17.12.59	..	..	82
29.4.60	..	..	149

Although providing of shade was found to be beneficial, it did not materially influence the activities of the animals to any appreciable extent.

SUMMARY

SIXTEEN observations on the grazing habits of cattle in relation to the seasonal utilization of pastures are described.

The average times spent in grazing, idling and lying down were 8.50 hr., 6.02 hr. and 9.47 hr. respectively.

The results of this study indicate that the condition of the pasture is a major factor which influences the grazing habits of cattle in the dry zone of Ceylon. The time spent in grazing was found to be correlated with the amount of green material present in the sward.

Grazing was done largely during the daylight hours, whilst the nights were mainly devoted to rest. Of the total grazing time, 75 per cent occurred during the day.

In the mornings, the animals grazed steadily, but not so intensively as in the afternoons. The last daylight grazing period was related to the time of sunset.

The provision of shade caused cattle to seek shelter during the hottest part of the day, but this did not materially influence the activities of animals.

No signs of heat distress were noted in any of these observations and as a breed, the Sahiwal is well adapted to climatic conditions of the dry zone.

It is suggested that further studies on the grazing habits of various breeds of cattle would be of considerable value in the selection of animals suited to different climatic zones of the island.

Tentative recommendations have been made for the improvement of grazing management practices.

ACKNOWLEDGMENTS

THE authors wish to record their thanks to officers of the Dry Zone Research Institute for assistance in the recording.

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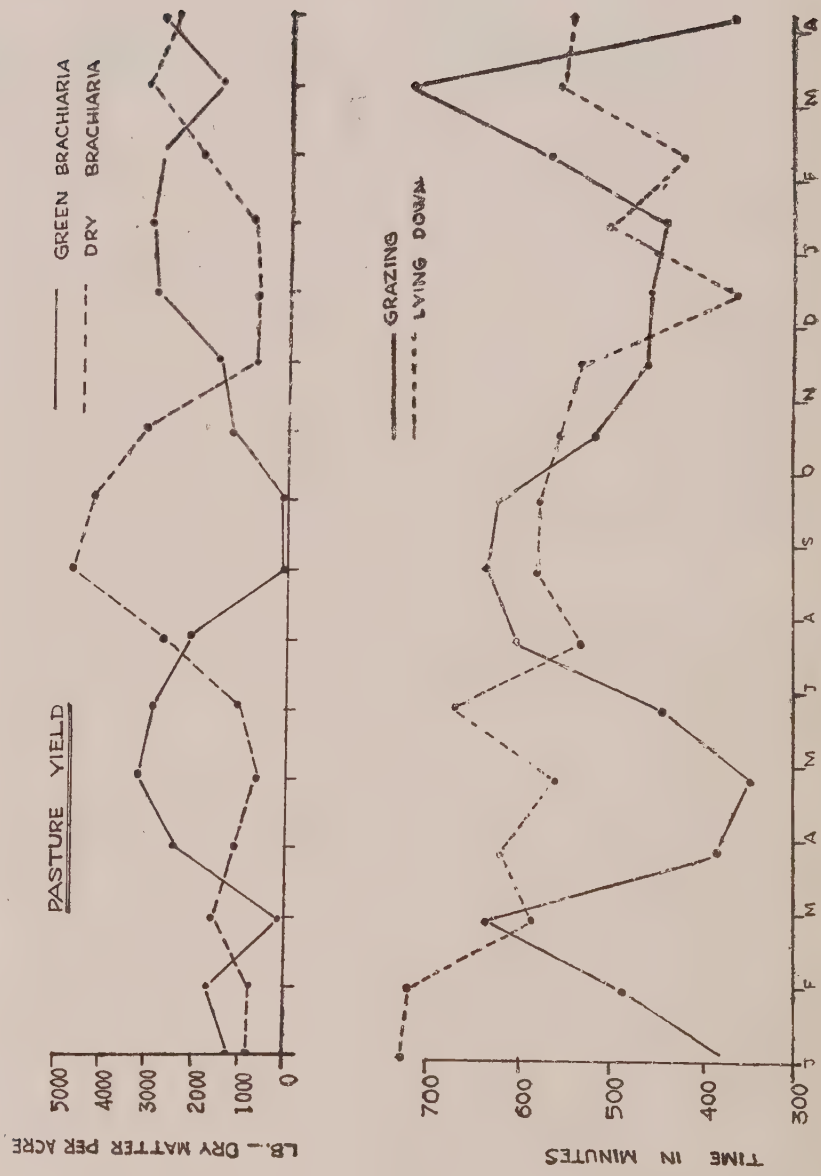


Fig. 1.—Showing the time spent in grazing and lying down in relation to pasture production.

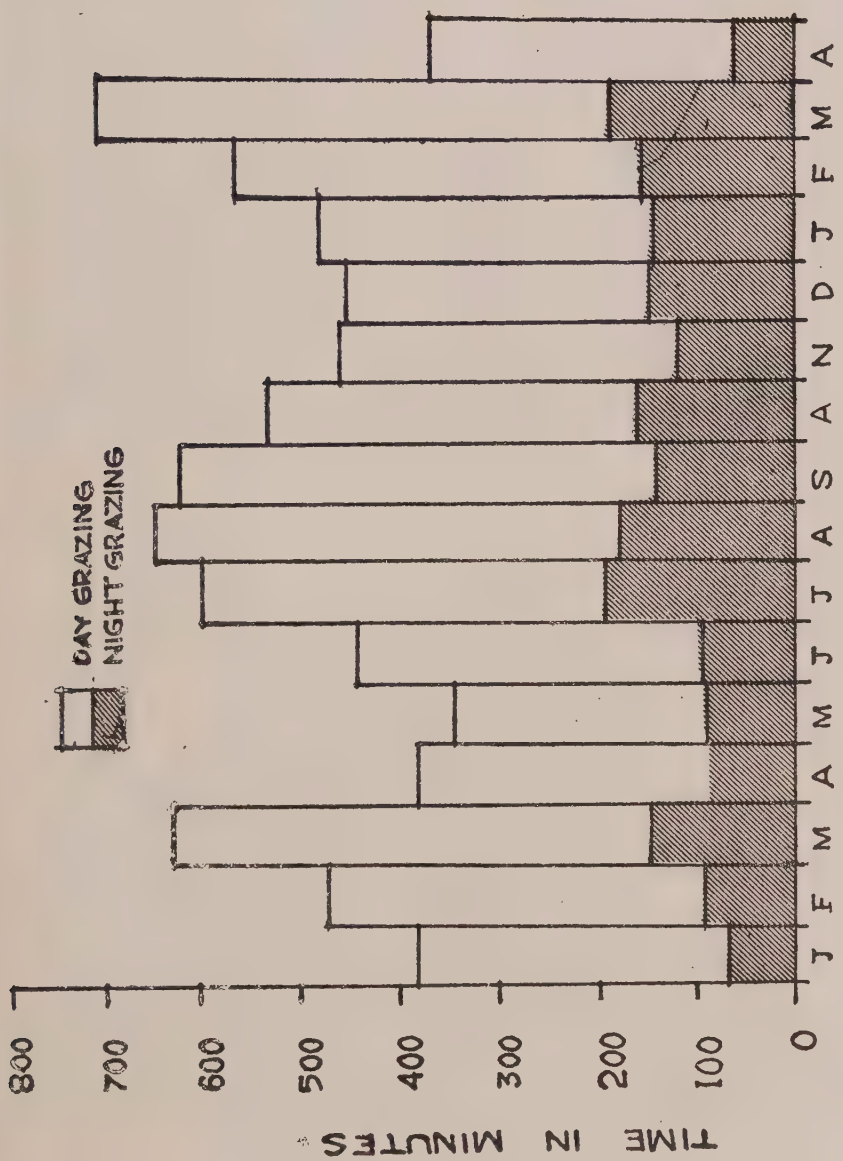


Fig. 2.—Showing total, day and night grazing. 1959

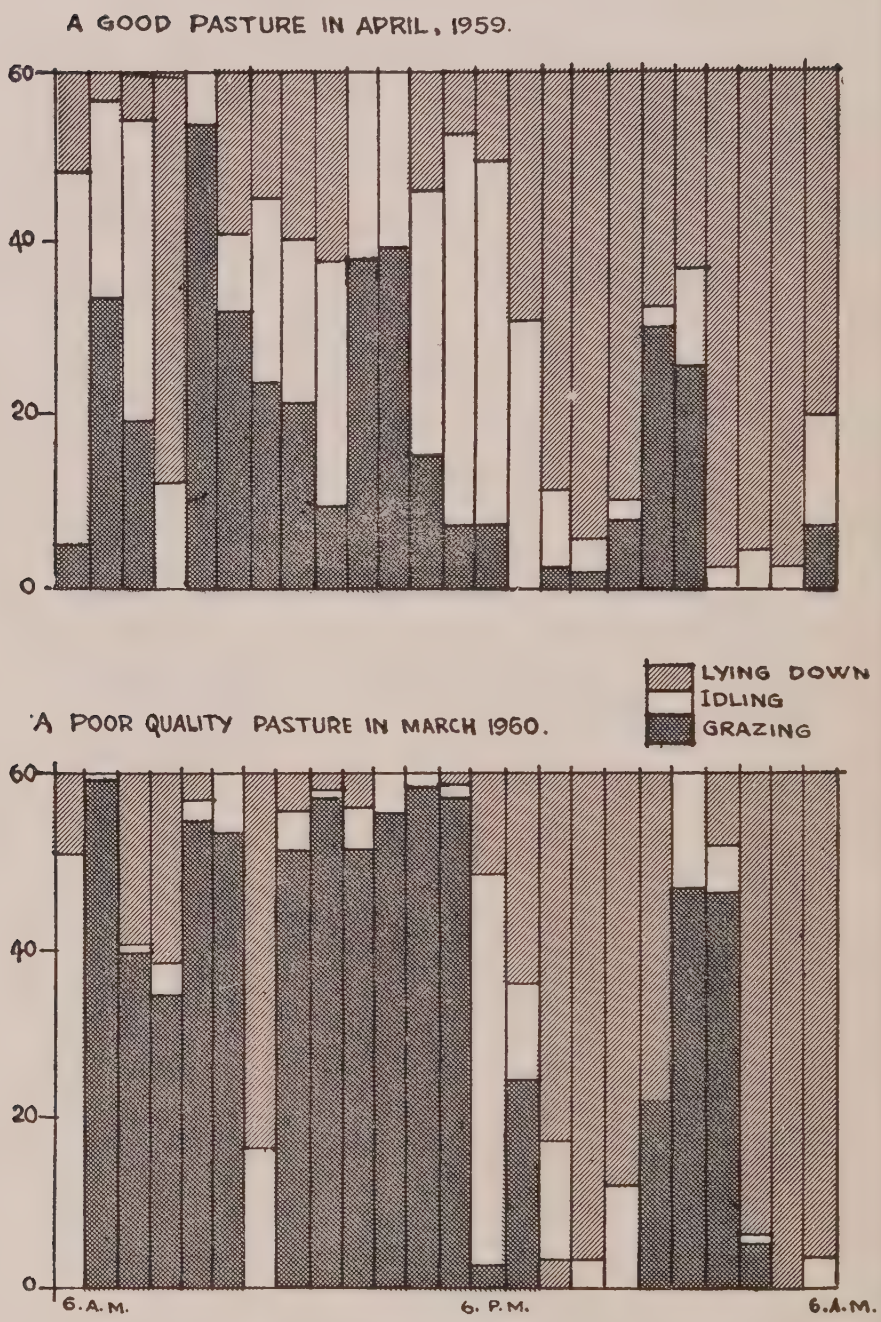
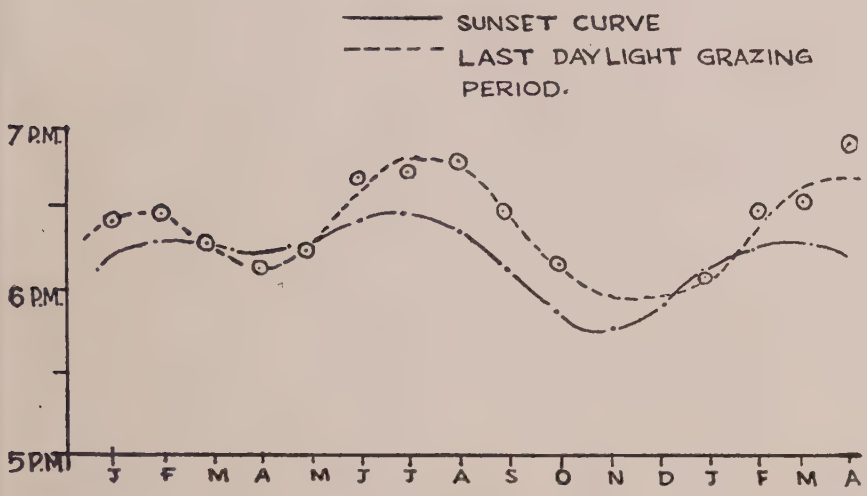


Fig. 3.—Periodicity of grazing habits on two pasture types.



1959—1960

Fig. 4—Showing the relationship between time of sunset and last daylight grazing period.

OBSERVATIONS ON THE RELATIVE SUSCEPTIBILITY OF THREE VARIETIES OF COTTON TO *APHIS GOSSYPII* GEVER

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Aphis gossypii Gever, the cotton aphid, is one of the more common and serious pests of cotton in the dry zone. The minute insects infest the tender portions of the plant in colonies and suck up the plant sap. The drainage caused to the plant by thousands of these creatures produces an unhealthy effect. The leaves become curled up, the tender portions fade gradually and the whole plant becomes blighted in a bad attack.

During routine checks on the pest, marked variations in the pest populations was observed in different varieties growing side by side. The present study is to ascertain if the difference was significant.

EXPERIMENT

Observations were made on three varieties of cotton, namely, Sea Island " Andrews " variety (*Gossypium barbadense*) and the upland varieties HC 101 and LL 53 (*G. hirsutum*). The varieties were planted at 3 ft. $\times$ 2 ft. spacing in plots 34 ft. $\times$ 14 ft. Each variety was grown under three fertilizer treatments, Nil, 40 lb. each of N and P_2O_5 and 80 lb. each of N and P_2O_5. N was applied in three split doses, first at the time of planting and then at three weeks and six weeks after planting. P_2O_5 was applied at the time of planting. There were four replications.

RESULTS

The results of the observations taken from 60 plants of each variety are given below in Table 1 and represented in Figure 1. It was observed that there was difference in the aphid infestation in the variety at different fertilizer levels. The observations for the Sea Island Variety for the three fertilizer levels is given below in Table II and also represented in Figure 2.

TABLE 1

Aphid Counts taken from Sixty Selected Plants from the Three Varieties

Variety	*Age of crop in weeks*							
	8	10	11	12	13	14	15	16
HC 101	4,900	11,000	15,000	1,300	915	2,350	2,800	1,135
Sea Island	580	875	215	100	15	215	10	20
LL53	2,400	6,050	3,300	1,300	1,000	2,000	2,200	1,500

TABLE II

Aphid counts taken on Sea Island variety at Three Fertilizer Levels

Fertilizer Level	*Age of crop in weeks*							
	8	10	11	12	13	14	15	16
Nil	25	255	55	0	10	80	10	5
40 lb. N & P_2O_5	75	150	90	45	5	70	0	0
80 lb. N & P_2O_5	490	470	70	55	0	65	0	15

DISCUSSION

FROM the observations it is clear that aphid infestation on Sea Island variety was significantly lower than in the other two varieties showing that this variety exhibits some form of resistance to aphids. It is difficult to state with any degree of certainty the particular attribute of the plants which confers this resistance. But evidence seems to suggest that hairiness of the leaves may have something to do with it. On the average leaves of Sea Island cotton have 1-5 hairs per square inch on the under surface whereas HC 101 has 500-600 and LL 53 has 800-900 hairs per square inch.

Peat (1928) found in South Africa that hairy cottons such as Cambodia suffered more than glabrous ones from aphid attack. Dinnam and Clark (1938) working in Mississippi, U.S.A., found that in a group of cotton varieties showing different levels of pilosity, the aphid population increased in direct proportion to the number of hairs on the lower leaf surfaces. In the present observation too it has been found that aphid infestation was lowest in the less hairy variety.

In nature aphids are controlled in varying degrees by natural enemies. Of these the more important are the larvae of a lady bird beetle, a hover fly and a lacewing fly. These larvae move freely on the under surface of the leaves and devour the aphids voraciously. Hairiness of the leaf is probably a hindrance to the free movement of these natural enemies and the aphids found among the hairs may not be easily accessible to the predators. Therefore resistance to aphids is probably a factor connected with predator activity on the

plant. Dinnam and Clark (1938) also observed that parasitism was greater in glabrous types of cotton with smaller aphid population. Here too hairiness of the leaves may make aphids less accessible to the parasites.

It was observed in the present study that with increased application of fertilizer the susceptibility to aphid infestation increased in all three varieties. This increase was more marked in the more resistant Sea Island variety. Probably more fertilizer, mainly the Nitrogen component, made leaves more succulent and therefore more attractive to aphids. Christidis and Harrision (1955) also reported that plants grown on soils well supplied with nitrogen were more favourable to aphid development. Another experiment is in progress with varying levels of nitrogen only to ascertain this fact.

SUMMARY

OBSERVATIONS made at Maha Illuppallama show that Sea Island Cotton variety, "Andrews" (*Gossypium barbadense*) is less susceptible to infestation by *Aphis gossypii* than the upland cotton varieties HC 101 and LL 53 (*G. hirsutum*). There was no difference in the succeptibility between HC 101 and LL 53.

In the very high fertilizer treatments all varieties showed greater susceptibility to aphids than in the moderate and no fertilizer treatments. This effect was, however, more marked in the "Andrews" variety.

ACKNOWLEDGMENT

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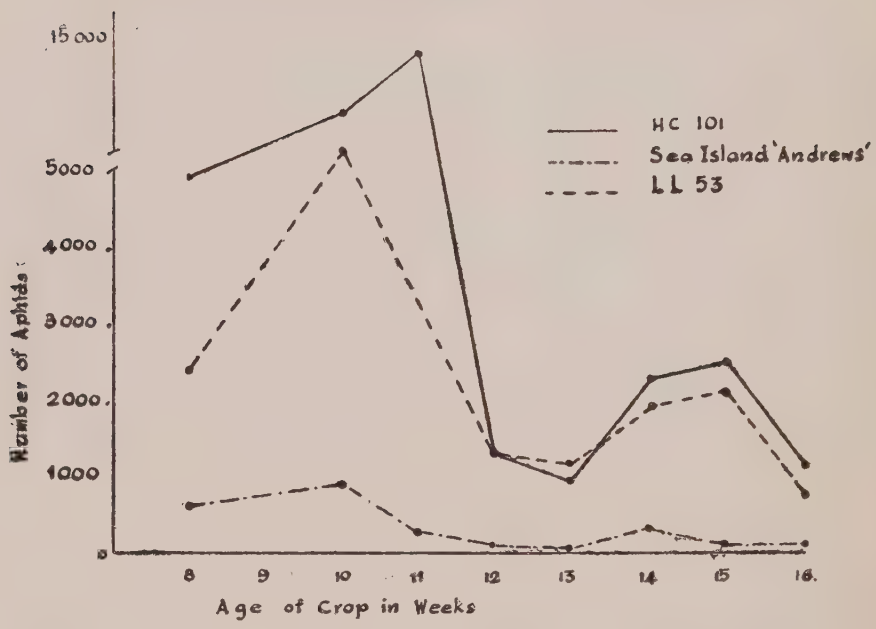

Fig. 1—Aphid counts taken from sixty selected plants in three varieties.

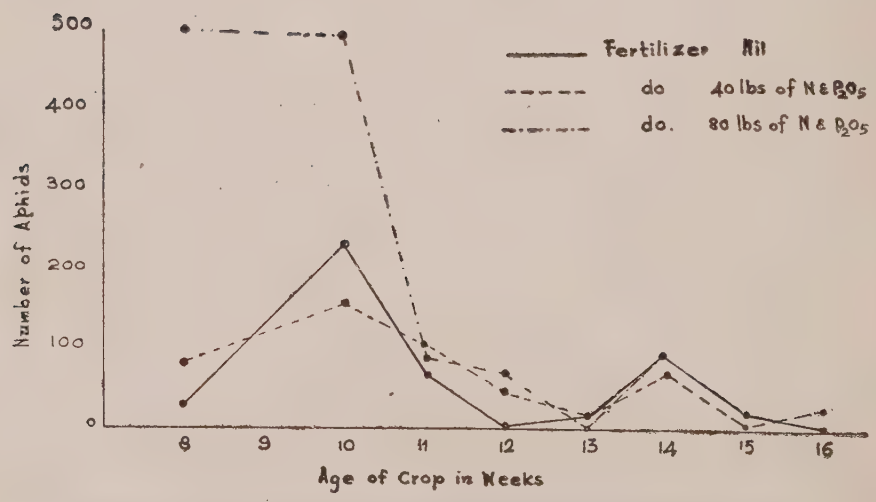

Fig. 2—Aphid counts taken from twenty plants of Sea Island variety at three fertilizer levels.

MAJOR INSECT PESTS OF BRINJAL (*SOLANUM MELONGENA*) AND THEIR CONTROL

E. S. Thevasagayam and L. S. C. Canagasingham
(Dry Zone Research Institute, Mahailluppallama)

Brinjal is often very seriously affected by insect pests, the more important ones being :

1. *Leucinodes orbonalis* G.—the shoot and fruit borer.

The caterpillar of this moth is found boring into shoots in young plants. The attacked shoots droop, fade and die off. These same caterpillars later bore into the fruits which show holes on the surface plugged with excreta.

2. *Epilachna 28-punctata* F., Epilachna beetles.

These beetles and their grubs scrape the green matter from the leaves and tender parts of the plant and when found in numbers they cause very severe damage to the plants.

3. *Aphis gossypii* Gever—Aphids.

These are found in abundance on the under surface of the leaves sucking the plant sap.

4. *Phenacoccus insolitus* G.—Brinjal mealy bug.

These generally attack isolated plants which appear as though covered with white powder. Badly affected plants are stunted and die very soon.

TRIALS FOR THE CONTROL OF INSECT PESTS

Trials for the control of these insects were conducted through three seasons at the Experimental Station, Tinnevely, using a wide range of insecticides.

At the first trial during yala 1960 the following insecticides were used :—

B. H. C. " Gammalin "	20% E. C *	1 fl. oz in 2 gal. water
D. D. T.	25% E. C.	1 fl. oz in 2 gal. water
Dieldrin	20% E. C.	1 fl. oz in 2 gal. water
Dipterex	80% W. S. P.†	1 oz wt. in 5 gal. water
Endrin	20% E. C.	1 fl. oz in 4 gal. water
Gusathion	20% E. C.	1 fl. oz in 4 gal. water
Malathion	50% E. C.	1 fl. oz in 4 gal. water
Parathion " Folidol "	46·7% E. C.	1 fl. oz in 8 gal. water
Rogor	40% E. C.	1 fl. oz in 8 gal. water

* E. C.—Emulsifiable concentrate.
† W. S. P.—Water soluble powder.

There was a heavy incidence of shoot borer and Epilachna beetles and the plants were badly affected. On the results of the above trial five promising insecticides were selected for further trials. These were B. H. C., Endrin, Gusathion, Parathion and Roger. To this list was added a new insecticide Sevin (I-naphyl N-Methylcarbamate) which had claims as a highly effective insecticide with very low residual toxicity. During maha 1960-61 these five insecticides were tried at the doses given against them.

B. H. C. " Gammalin "	20% E. C.	Low	1 oz in 2 gal. water
		High	1 oz in 1 gal. water
Endrin	20% E. C.	Low	1 oz in 4 gal. water
		High	1 oz in 2 gal. water
Gusathion	20% E. C.	Low	1 oz in 4 gal. water
		High	1 oz in 2 gal. water
Parathion " Folidol "	46·7% E. C.	Low	1 oz in 8 gal. water
		High	1 oz in 4 gal. water
Rogor	40% E. C.	Low	1 oz in 8 gal. water
		High	1 oz in 4 gal. water
Sevin	50% W. W. P.*	Low	1 oz in 1 gal. water
		High	2 oz in 1 gal. water

* Water wettable Powder.

Fortnightly observations of shoot borer, Epilachna grubs and aphid incidence were taken. Shoot borer incidence was estimated on the basis of a total count of affected shoots and the results are given in Table I and Figure 1. Epilachna grubs were counted on every fifth plant in the plot and these figures are given in Table II and Figure 2. Aphid counts were taken from five selected plants in each plot. When aphid numbers were heavy they were estimated in hundreds and thousands. The results are given in Table III and Figure 3.

If after each fortnightly observation the pest incidence was found to be high, the crop was sprayed. Altogether the crop was sprayed seven times during the trial, the first application being when the crop was six weeks old.

The yield results are given in Table V. At harvest the attacked fruits were separated from the good ones and weighed separately. Records were also kept of the number of punctures on each attacked fruit which gave an indication of the intensity of fruit borer attack. Altogether thirteen picks were taken from the crop.

DISCUSSION

FROM observations of pest incidence and from yields it is evident that Sevin at the high concentration gave the best control of shoot and fruit borer and Epilachna grubs. Endrin, B. H. C. and Gusathion also gave very satisfactory control of these two pests and the first two gave good yields too. Sevin however did not give any control of Aphids which were controlled best by Rogor, Endrin and B. H. C. The Aphid population in the Sevin treated plots was much higher than even the untreated controls as Figure 3 would show. This phenomenon is difficult to explain but it may be due to the fact that aphids were being controlled by their natural enemies in the untreated plots whereas in the Sevin treated plots the natural enemies were being killed by the Sevin.

Sevin at the high concentration gave a yield of 400 lb. of good fruits, the equivalent of 16,000 lb. per acre and about 2,400 lb. per acre of attacked fruits. The yield from the untreated area was 115 lb. or 4,600 lb. per acre, just over a fourth of the Sevin treated plot. Endrin and B. H. C. at the high concentration gave yields of 14,700 lb. and 13,120 lb. respectively per acre and Sevin at the lower concentration nearly 13,000 lb. per acre.

The high concentration of Sevin used in the trial was a 0.6 per cent strength and at normal coverage at this rate the amount of insecticide used is about 2.5 lb. per acre. The cost of insecticide per application would be about Rs. 20 or about Rs. 175 for the season. The increase in the present experiment by use of Sevin over the untreated control is nearly 12,000 lb.

YALA 1961 TRIAL

ON the basis of good insect control and low residual toxicity Sevin and B. H. C. were selected from the earlier experiment for a further trial at the following three concentrations :—

B. H. C. 1	..	½ fl. oz in 1 gal. water
B. H. C. 2	..	1 fl. oz in 1 gal. water
B. H. C. 3	..	2 fl. oz in 1 gal. water
Sevin 1	..	1½ oz in 1 gal. water
Sevin 2	..	1 oz in 1 gal. water
Sevin 3	..	2 oz in 1 gal. water

There were three untreated controls per replicate and there were three replications.

The same observations were taken as in the earlier trial. The shoot borer figures are given in Table IV and Figure 4. The yields are given in Table VI.

DISCUSSION

HERE again Sevin gave a very high yield at the high concentration of 290 lb. or nearly 18,000 lb. per acre. The yields at the lower concentrations were 13,600 lb. and 9,800 lb. respectively. B.H.C. at the high concentration gave nearly 13,300 lb. about the same as in the earlier trial. The comparative yield in the untreated control was 9,400 lb. per acre. Sevin therefore gave a yield double that of the untreated control.

From the trials it is possible to state that Sevin at the rate of 2.5 lb. per acre would give excellent control of the shoot and fruit borer and Epilachna beetles. It is ineffective against aphids and mealy bugs which could be controlled by Rogor, Endrin, B. H. C. or Malathion. B. H. C. could be second choice for the control of all the major pests of brinjal.

Sevin is a very safe insectide tc use, its acute oral LD_{50} for rats being 540 mg. per kg. body weight compared to D. D. T. 250, Lindane 125, Endrin 10 and Parathion 3. Its residual toxicity is also very low and a crop could be sprayed with Sevin even up to the time of harvesting.

SUMMARY

THE more important insect pests that cause severe damage to brinjal in the Jaffna peninsula and other parts of the dry zone are (1) *Leucinodes orbonalis*—the shoot and fruit borer, (2) *Epilachna 28-punctata* —Epilachna beetle, (3) *Aphis gossypii*—aphids, and (4) *Phenacoccus insolitus*—brinjal mealy bug.

Trials were conducted at the Experimental Station, Tinnevely, for the control of these pests, with B. H. C., D. D. T. Dipterex, Dieldrin, Endrin, Gusathion, Malathion, Parathion, Rogor and Sevin. Of these Sevin gave very good control of the shoot borer and Ephilachna grubs. This insecticide however was ineffective against aphids which were controlled best by Rogor and Endrin.

ACKNOWLEDGMENTS

THE authors are indebted to Mr. K. Pathmanathan, Agricultural Research Officer, Northern Division, and Mr. R. Ragupathy, Officer-in-Charge (Research), Tinnevely, for their corporation and help during the entire period, to Mr. S. Ponniah, Laboratory Assistant for his assistance in the field observations and to Mr. P. Kanapathippillai, Statistition, Department of Agriculture, for his help with the analysis.

TABLE I

Number of Brinjal shoots attacked by Borer in the Different Treatments during Maha 1960-61

Treatment		Age of crop in weeks						
		6	8	10	12	14	16	18
B. H. C.	Low	0	1	3	11	25	8	19
	High	0	0	2	9	21	7	10
Endrin	Low	0	0	2	2	1	13	14
	High	0	0	4	4	2	6	20
Gusathion	Low	0	1	5	25	13	15	21
	High	0	0	1	5	8	13	20
Parathion	Low	0	0	3	14	12	16	28
	High	0	0	7	8	11	42	40
Rogor	Low	1	3	5	9	6	38	50
	High	0	0	7	56	6	40	49
Sevin	Low	0	0	0	4	0	11	7
	High	0	0	0	0	0	2	7
Control	1	3	4	10	33	38	46	50
	2	0	3	20	26	40	20	20

TABLE II

Number of Epilachna grubs from the Different Treatment during Maha 1960-61

Treatment		Age of crop in weeks							
		4*	6	8	10	12	14	16	18
B. H. C.	Low	100	180	0	45	375	685	210	40
	High	55	70	130	130	700	1,030	710	105
Endrin	Low	125	25	0	15	215	292	180	35
	High	70	5	0	5	35	77	55	35
Gusathion	Low	65	10	0	15	55	48	155	30
	High	25	45	0	0	25	35	90	15
Parathion	Low	55	15	0	30	115	105	105	15
	High	75	25	0	10	80	91	93	30
Rogor	Low	125	30	0	30	50	173	205	15
	High	55	10	0	10	0	168	110	30
Sevin	Low	35	0	0	10	0	0	0	3
	High	165	0	0	10	0	0	0	2
Control	1	80	65	16	170	715	651	360	120
	2	40	45	50	105	350	660	570	50

* Before treatment.

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TABLE III

Number of Aphids in Five Selected Plants in Different Treatments during Maha 1960-61

Treatment		Age of crop in weeks						
		6	8	10	12	14	16	18
B. H. C.	Low	0	50	0	100	380	75	140
	High	0	10	0	600	1,000	55	80
Endrin	Low	0	150	0	415	400	365	25
	High	0	0	0	75	140	5	45
Gusathion	Low	0	0	15	500	0	50	15
	High	20	0	0	0	0	10	40
Parathion	Low	0	0	0	275	155	180	40
	High	0	15	0	300	75	5	25
Rogor	Low	0	0	0	75	325	60	15
	High	0	0	0	50	130	80	45
Sevin	Low	50	2,100	30,000	30,000	27,000	4,500	130
	High	25	3,800	45,000	52,000	60,000	15,000	105
Control	1	0	50	200	1,250	2,600	1,650	250
	2	0	0	300	13,000	2,000	1,250	275

TABLE IV

Number of Brinjal shoots attacked by Borer in Different Treatments during Yala 1961

Treatment		Age of crop in weeks						
		4	6	8	10	12	14	16
B. H. C.	1	0	0	4	25	37	41	20
	2	0	0	4	19	29	37	14
	3	0	0	2	20	28	38	17
Sevin	1	0	0	0	19	17	20	8
	2	0	0	4	16	11	9	3
	3	0	0	3	11	0	1	1
Control	1	0	0	7	20	56	92	36
	2	0	1	4	30	63	77	48
	3	0	0	0	30	62	96	36

TABLE V

Weight in pounds of good and attacked fruits of Brinjal obtained from 21 ft. × 18 ft. plots in the Different Treatments in the Maha 1960-61 Trial

Treatment		Replicate 1		Replicate 2		Replicate 3		Total	
		Good	Attacked	Good	Attacked	Good	Attacked	Good	Attacked
B. H. C.	Low	85·4	27·5	81·3	33·3	56·0	30·9	222·7	91·7
	High	116·2	24·7	105·0	22·9	106·6	28·6	327·8	76·2
Endrin	Low	88·6	26·4	99·8	36·3	88·6	37·8	277·0	100·5
	High	127·5	16·5	149·3	32·0	86·1	22·7	362·9	71·2
Gusathion	Low	67·5	34·0	79·9	56·6	74·9	33·6	222·3	124·2
	High	79·1	41·4	100·2	47·0	48·1	30·6	227·4	119·0
Parathion	Low	56·3	34·0	47·8	32·4	34·2	32·5	138·3	98·9
	High	37·4	26·4	63·0	55·2	26·0	31·2	126·4	112·8
Rogor	Low	47·5	33·0	62·1	52·3	47·6	34·0	157·2	119·3
	High	51·9	42·9	67·7	43·6	51·2	43·9	170·8	130·4
Sevin	Low	116·2	20·6	104·2	27·7	104·1	32·0	324·5	80·3
	High	118·5	20·4	125·5	16·6	155·5	24·6	399·5	61·6
Control	1	36·6	38·7	23·0	23·5	29·6	33·7	89·5	95·9
	2	63·8	40·9	48·3	32·2	26·1	24·4	138·2	97·5

TABLE VI

Weight in pounds of good and attacked fruits of Brinjal obtained from 18 ft. × 12 ft. plots in the Different Treatments in the Yala 1961 Trial

Treatment		Replicate 1		Replicate 2		Replicate 3		Total	
		Good	Attacked	Good	Attacked	Good	Attacked	Good	Attacked
B. H. C.	1	51·4	24·3	56·5	36·9	49·2	29·3	157·1	90·5
B. H. C.	2	53·9	20·5	45·4	23·5	40·9	33·4	140·2	77·4
B. H. C.	3	66·1	35·8	63·4	33·4	69·8	45·3	199·3	114·5
Sevin	1	42·5	24·1	58·1	29·6	45·1	33·9	145·8	87·6
Sevin	2	53·6	32·3	82·8	36·0	68·7	31·0	205·1	99·3
Sevin	3	83·4	21·1	127·5	24·9	78·9	37·6	289·8	83·6
Control	1	43·9	27·7	48·0	26·4	43·1	23·7	135·0	77·8
Control	2	41·4	21·8	63·9	36·8	35·1	24·6	140·4	83·2
Control	3	52·1	31·8	39·0	24·1	52·6	28·8	143·7	84·7

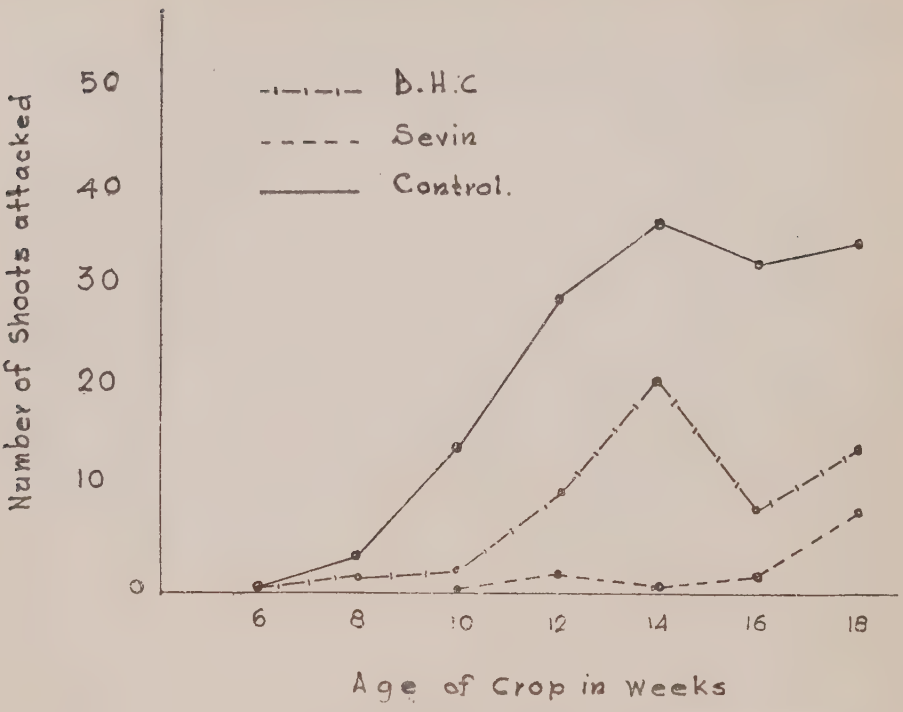

Fig. 1—Number of brinjal shoots attacked by borer in the different treatments during Maha 1960–61.

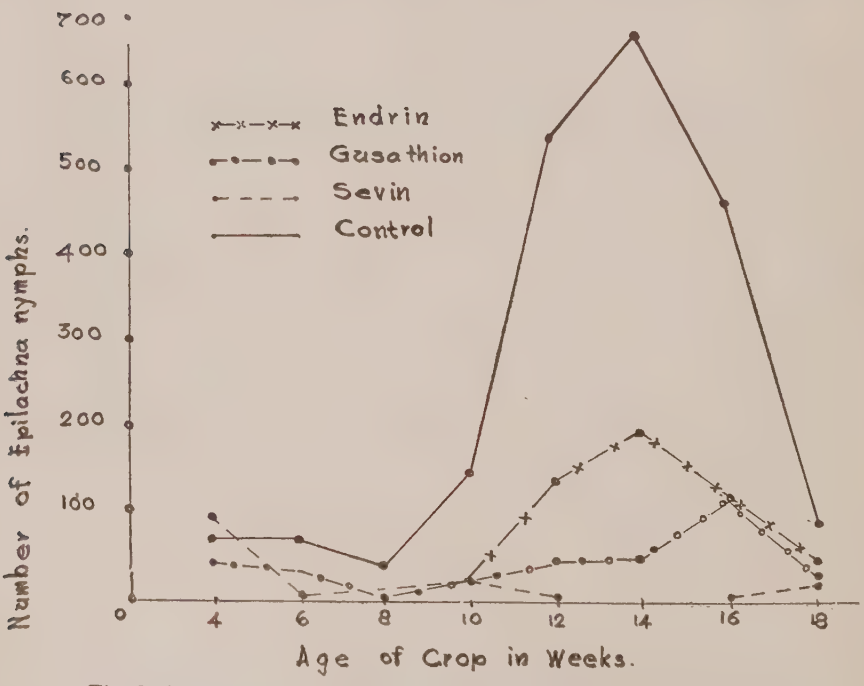

Fig. 2—Number of Epilachna nymphs in the different treatments during Maha 1960–61.

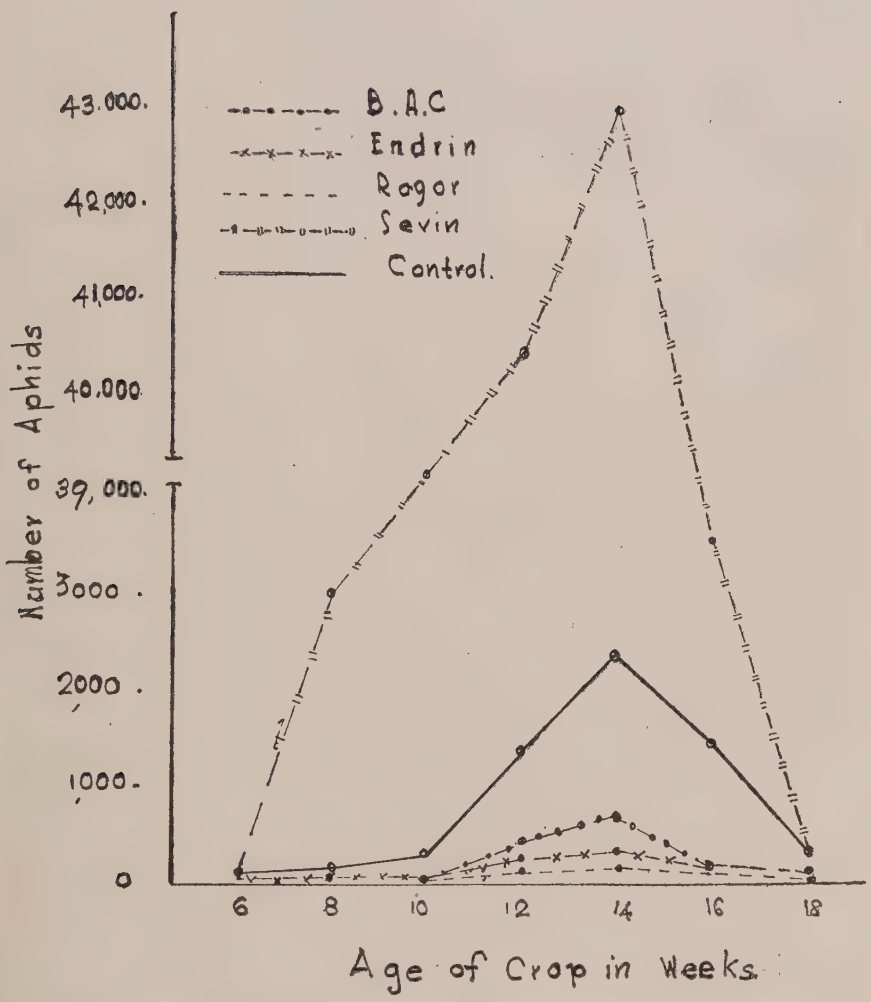

Fig. 3—Number of aphids in the different treatments during Maha 1960–61.

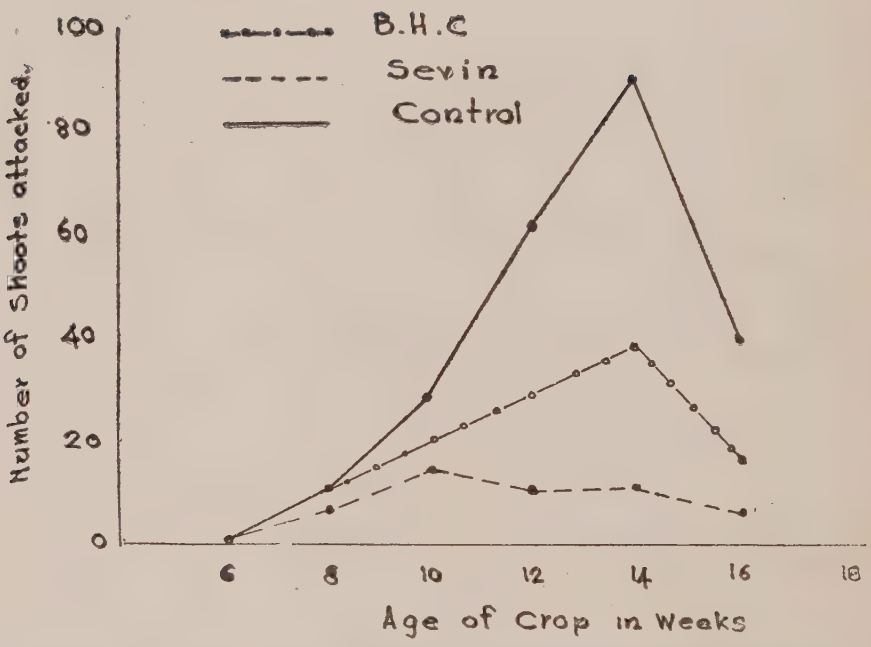

Fig. 4—Number of brinjal shoots attacked by borer in the different treatments during Yala 1961.

A PRELIMINARY LIST OF THE NATIVE PARASITES AND PREDATORS OF INSECT PESTS IN CEYLON

(Compiled by MERVYN D. DE SILVA—Agricultural Research Station, Rahangala.)

THIS preliminary list of the Native Parasites and Predators of Insect Pests in Ceylon has been compiled by reference to available literature on our beneficial insects and with the aid of records maintained by earlier entomologists of this country. Where possible, the source of the information has been furnished.

Host Species	*Parasite or Predator*	*Authority*
COLEOPTERA :		
Aulacophora cinta Baly. (Galerucid)	*Medinodexia fluviventris* Towns (Dipt. Tachinid)	Baranoff (1934)
Aulacophora foveicollis F. (Galerucid)	*Medinodexia fluviventris* Towns (Dipt. Tachinid)	,,
Calandra oryzae L. (Curculionid)	*Aplastomorpha calandrae* How. (Hym. Pteromalid)	*
	Chaetospila elegans Westward (Hym. Pteromalid)	*
Chilomenes sex-maculate F. (Coccinellid)	*Tetrastichus coccinellilae* Kurdj. (Hym. Eulophid)	Gadd (1949)
Dinoderus brevis Horn. (Bostrychid)	*Spathus bisignatus* Walk. (Hym. Braconid)	Beeson and Chatterjee (1935a)
Dinoderus minutus F. (Bostrychid)	*Spathus bisignatus* Walk. (Hym. Braconid)	,,
Dinoderus ocellaris Steph. (Bostrychid)	*Spathus bisignatus* Walk. (Hym. Braconid)	,,
Scymnus sp. (Coccinellid)	*Syntomosphyrum taprobanes* Waterston (Hym. Eulophid)	Waterston (1915)
Xylotrechus quadripes Chevr. (Cerambycid)	*Xylonomus caerulescens* Morl. (Hym. Ichneumonid)	Beeson and Chatterjee (1935b)

Note.—The asterisk (*) appearing in this article refers to unpublished records of the Division of Entomology, Peradeniya.

Host Species	*Parasite or Predator*	*Authority*
DIPTERA :		
Agromyza phaseoli Coq. (Agromyzid) ..	*Polycystus propinquus* Waterston (Hym. Pteromalid) ..	Waterston (1915)
	Trigonogastra rugosa Waterston (Hym. Pteromalid) ..	,,
Agromyza sp. (Agromyzid) ..	*Polycystus propinquus* Waterston (Hym. Pteromalid) ..	,,
	Sympiesis purpureus Waterston (Hym. Eulophid) ..	Ayyar (1925)
	Trigonogastra bruneicornis Ferr. (Hym. Pteromalid) ..	Ferriere (1930)
Dacus curcubitae Coq. (Trypetid) ..	*Melettobia* sp. (Hym. Eupelmid) ..	Fernando (1954)
	Opius compensans Silv. (Hym. Braconid) ..	*
	Opius fletcheri Silv. (Hym. Braconid) ..	Hutson (1936)
	Opius incisi Silv. (Hym. Braconid) ..	Fernando (1954)
	Opius longicaudatus Ash. (Hym. Braconid) ..	Hutson (1936)
	Spalangia sp. (Hym. Pteromalid) ..	*
	Zeteticontus sp. (Hym. Eupelmid) ..	Fernando (1954)
Dacus dorsalis Head. (Trypetid) ..	*Spalangia* sp. (Hym. Pteromalid) ..	New record
	Syntomosphyrum indicum Silv. (Hym. Eulophid) ..	,,
Dacus ferrugineus F. (Trypetid) ..	*Diachasma* sp. (Hym. Braconid) ..	*
	Opius carpomyiae Silv. (Hym. Braconid) ..	*
	Opius compensans Silv. (Hym. Braconid) ..	*
Dacus zonatus Saund. (Trypetid) ..	*Opius carpomyiae* Silv. (Hym. Braconid) ..	*
	Syntomosphyrum indicum Silv. (Hym. Eulophid) ..	*
Melanagromyza theae de Mejere (Agromyzid) ..	*Closterocerus insignis* Waterston (Hym. Eulophid) ..	Waterston (1915)
	Trigonogastra sp. (Hym. Pteromalid) ..	Gadd (1945)

Host Species	*Parasite or Predator*	*Authority*
Pachydiplosis oryzae W-M. (Cecidomyiid) ..	*Casnoidea interstitialis* Schm. (Col. Carabid) ..	New record
	Nabis capsiformis Germ. (Hem. Nabid) ..	New record
	Platygaster oryzae Cameron (Hym. Scelionid) ..	New record
Stomatomyia bezziana Bar. (Tachinid) ..	*Syntomosphyrum* sp. near *obscuriceps* Ferr. (Hym. Eulophid) ..	Ferriere (1940)
HEMIPTERA :		
Aclerda distorta Green (Coccid) ..	*Coccophagus zebratus* How. (Hym. Aphelinid) ..	Compere (1931a)
Adonaspis (*Aspidiotus*) *secretus* Cockerell (Coccid) ..	*Homalopoda cristata* How. (Hym. Chalcid) ..	Green (1896)
Aleurocanthus woglumi Ashby (Aleyrodid) ..	*Ablerus connectens* Silv. (Hym. Aphelinid) ..	Silvestri (1927)
	Eretmocerus serius Silv. (Hym. Aphelinid) ..	Clausen and Berry (1932)
	Prospaltella smithi Silv. (Hym. Alphelinid) ..	Silvestri (1927)
	Scymnus (*clitostethus*) *fumatus* Sicard. (Col. Coccinellid) ..	Sicard (1929)
Amorphococcus mesuae Green (Coccid) ..	*Eupelmus amorphococci* Ashm. (Hym. Eupelmid) ..	Green (1909)
Aonidia corniger Green (Coccid) ..	*Encarsia aonidiae* How, (Hym. Aphelinid) ..	Green (1896)
Aphis gossypii Glov. (Aphidid) ..	*Aspidimerus circumflexus* Mots. (Col. Coccinellid) ..	*
	Illeis cincta F. (Col. Coccinellid) ..	Hutson (1931)
	Ischiodon scutellaris F. (Dipt. Syrphid) ..	"
Aphis laburni Kalt. (Aphidid) ..	*Coccinella repanda* Thunb. (Col. Coccinellid) ..	New record
	Chilomenes sex-maculata F. (Col. Coccinellid) ..	"
	Illeis cinta F. (Col. Coccinellid) ..	Hutson (1931)
Aspidiotus destructor Sign. (Coccid) ..	*Chilocorus nigritus* F. (Col. Coccinellid) ..	Hutson (1934)
Aspidiotus lantanae Sign. (Coccid) ..	*Chilocorus circumdatus* Schonh. (Col. Coccinellid) ..	Dupont (1920)
	Dentifibula obtusilobae Felt. (Dipt. Cecidomyiid) ..	Barnes (1930)

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Host Species	*Parasite or Predator*	*Authority*
Asterolecanium sp. (Coccid) ..	*Encarsia planchoniae* How. (Hym. Aphelinid) ..	Ayyar (1925)
Asterolecanium delicatum Green (Coccid) ..	*Adelencyrtus planchoniae* How. (Hym. Encyrtid) ..	"
Aulacaspis flacourtiae Rutherford (Coccid) ..	*Chilocorus circumdatus* Schonh. (Col. Coccinellid) ..	Rutherford (1914)
Aulacaspis sp. near *pentagona* (Coccid) ..	*Aspidiotiphagus citrinus* Craw. (Hym. Aphelinid) ..	Green (1896)
	Dyodiplosis generosi Felt. (Dipt. Cecidomyiid) ..	Barnes (1930)
Bagrada picta F. (Pentatomid) ..	*Cydnocoris crocatus* St. (Hem. Reduviid) ..	*
	Sarcophaga albiceps Meig. (Dipt. Sarcophagid) ..	*
	Sarcophaga kempi Senior White (Dipt. Sarcophagid) ..	Baranoff (1934)
Bemisia tabaci Genn. (Aleyrodid) ..	*Encarsia* sp. (Hym. Aphelinid) ..	Fernando (1954)
	Prospaltella sp. (Hym. Aphelinid) ..	New record
Canthecona robusta Dist. (Pentatomid) ..	*Telenomus* sp. (Hym. Aphelinid) ..	**
Cerococcus ornatus Green (Coccid) ..	*Cephaleta purpureiventris* Mots. (Hym. Pteromalid) ..	Green (1909)
Ceronema koebelei Green (Coccid) ..	*Aphycus lichtensiae* How. (Hym. Encyrtid) ..	Ayyar (1925)
Ceroplastes actiniformis Green (Coccid) ..	*Aneristus ceroplastrae* How. (Hym. Aphelinid) ..	Gahan (1924)
Chionaspis albizzae Mask. (Coccid) ..	*Aphytis diaspidis* How. (Hym. Aphelinid) ..	Green (1899)
	Chilocorus circumdatus Schonh. (Col. Coccinellid) ..	"
	Prospaltella aurantii How. (Hym. Aphelinid) ..	"
Chionaspis elaeagni Green (Coccid) ..	*Aphytis mytilaspidis* LeB. (Hym. Aphelinid) ..	"
	Phycus varicornis How. (Hym. Aphelinid) ..	"

Host Species	*Parasite or Predator*	*Authority*
Chionaspis graminis Green (Coccid) ..	*Adelencyrtus chionaspidis* How. (Hym. Encyrtid) ..	Ayyar (1925)
	Aphelinus mytilaspidis LeB. (Hym. Aphelinid) ..	Howard and Ashmead (1896)
	Aspidiotiphagus citrinis Craw. (Hym. Aphelinid) ..	Waterston (1917)
Chionaspis mussaendae Green (Coccid) ..	*Adelencyrtus chionaspidis* How. (Hym. Encyrtid) ..	Green (1899)
	Aphytis diaspidis How. (Hym. Aphelinid) ..	,,
Coccus viridis Green (Coccid) ..	*Aneristus ceroplastae* How. (Hym. Aphelinid) ..	Keuchenius (1915)
	Anicetus ceylonensis How. (Hym. Encyrtid) ..	,,
	Crytoblabes prolencella Hamps. (Lep. Pyralid) ..	*
	Exochomus nigromaculatus (Col. Coccinellid) ..	Green (1899)
	Microterys flavus How. (Hym. Encyrtid) ..	Keuchenius (1915)
Diaspis amygdali Tyron (Coccid) ..	*Aspidiotiphagus citrinus* Craw. (Hym. Aphelinid) ..	Green (1896)
Diaspis permutans Green (Coccid) ..	*Aphytis mytilaspidis* LeB. (Hym. Aphelinid) ..	Howard and Ashmead (1896)
Dysdercus cingulatus F. (Pyrrhocorid) ..	*Antilochus nigripes* Burm. (Hem. Pyrrhocorid) ..	Hutson (unpublished)
	Antilochus pygaeus Dist. (Hem. Pyrrhocorid) ..	,,
	Serinetha abdominalis F. (Hem. Coreid) ..	Green (1909)
Eriococcus rhodomytri Green (Coccid) ..	*Adelencyrtus solidus* How. (Hym. Encyrtid) ..	Ayyar (1925)
Eriococcus sp. (Coccid) ..	*Litus enocki* How. (Hym. Mymarid) ..	Howard and Ashmead (1896)
Fiorinia saprosemae Green .. (Coccid) ..	*Arrhenophagus chionaspidis* Aur. (Hym. Encyrtid) ..	Green (1896)
Howardia biclavis Comst. (Coccid) ..	*Dyodiplosis generosi* Felt. (Dipt. Cecidomyiid) ..	Barnes (1930)
Icerya aegyptiaca Dougl. (Coccid) ..	*Masicera* sp. (Dipt. Tachinid) ..	*
Icerya purchasi Mask. (Coccid) ..	*Novius roseipennis* Muls. (Col. Coccinellid) ..	*

Host Species	*Parasite or Predator*	*Authority*
Laccifer albizziae Green (Coccid) ..	*Aphrastobracon flavipennis* Ashm (Hym. Braconid) ..	Cameron (1913)
	Eublemma amabilis Mo. (Lep. Noctuid) ..	Green (1922)
	Eublemma coccidiphaga Hmp. (Lep. Noctuid) ..	Rutherford (1914)
	Eupelmus tachardiae How. (Hym. Eupelmid) ..	Cameron (1913)
	Holcopelte sp. (Hym. Eulophid) ..	,,
	Microbracon greeni How. (Hym. Braconid) ..	,,
	Tachardiaephagus tachardiae How. (Hym. Encyrtid) ..	,,
Laccifer lacca Kerr. (Coccid) ..	*Copidosoma clavicornis* Cam. (Hym. Encyrtid) ..	Jepson (1935)
	Eublemma amabilis Mo. (Lep. Noctuid) ..	Green (1922)
	Eupelmus tachardiae How. (Hym. Eupelmid) ..	Pinto (1940)
	Holocera pulverce (Lep. Pyralid) ..	,,
	Marietta sp. (Hym. Aphelinid) ..	Green (1922)
	Tachardiaephagus tachardiae How. (Hym. Encyrtid) ..	Jepson (1935)
	Tetrastichus purpureus Cam. (Hym. Enlophid) ..	,,
Lecanium piperis Green (Coccid) ..	*Microterys flavus* How. (Hym. Encyrtid) ..	Ayyar (1925)
Leptocorisa varicornis F. (Coreid) ..	*Asopus malabricus* (Hem. Pentatomid) ..	Austin (1922)
	Canthecona robusta L. (Hem. Pentatomid) ..	Hutson (unpublished)
	Cicindela sex-punctata F. (Col. Cicindelid) ..	Austin (1922)
	Harpector fuscipes (Hem. Reduviid) ..	,,
	Irantha sp. (Hem. Reduviid) ..	,,
Lichtensia sp. (Coccid) ..	*Aphycus lichtensensiae* How. (Hym. Encyrtid) ..	Timberlake (1916)
Maskellia zonta (Coccid) ..	*Anagyrus greeni* How. (Hym. Encyrtid) ..	Howard and Ashmead (1896)
Melamphaus fulvomarginatus (Pyrrhocorid) ..	*Antilochus nigripes* Burm. (Hem. Pyrrhocorid) ..	**
Myzus persicae Sulz. (Aphidid) ..	*Illeis cincta* F. (Col. Coccinellid) ..	Hutson (1931)
Nephotettix bipunctatus F. (Jassid) ..	*Coccinella octomaculata* F. (Col. Coccinellid) ..	New record

Host Species	*Parasite or Predators*	*Authority*
Odonaspis secreta Ckll. (Coccid)	*Homalopoda cristata* How. (Hym. Encyrtid)	Ayyar (1925)
Oregma bambusae Buck. (Aphidid)	*Crytoblabes prolencella* Hamps. (Lep. Pyralid)	*
Otinotus oneratus Wlk. (Membracid)	*Centrobia* sp. (Hym. Trichogrammid)	*
Pentalonia nigronervosa (Aphidid)	*Sphaerophoria scutella* F. (Dipt. Syrphid)	*
	Asarcina aegorta F. (Dipt. Syrphid)	*
Pinnaspis (chionaspis) aspidistrae Sign. (Coccid)	*Chilocorus circumdatus* Schonh. (Col. Coccinellid)	Green (1896)
	Dentrifibula obtusilobae Felt (Dipt. Cecidomyiid)	Barnes (1930)
Pinnaspis temporaria Ferris (Coccid)	*Aphytis diaspidis* How. (Hym. Aphelinid)	Dupont (1931)
	Prospaltella aurantii How. (Hym. Aphelinid)	"
	Prospaltella berlessei How. (Hym. Aphelinid)	"
Pseudaulacaspis pentagona Targ. (Coccid)	*Dyodiplosis generosi* Felt (Dipt. Cecidomyiid)	Barnes (1930)
Pseudococcus (Dactylopius) citri Risso. (Coccid)	*Exochomus nigro-maculatus* (Col. Coccinellid)	*
	Spalgis epius Westw. (Lep. Lycaenid)	Hutson (unpublished)
Pseudococcus lilacinus Ckll. (Coccid)	*Spalgis epius* Westw. (Lep. Lycaenid)	Green (1922)
Pseudococcus sp. (Coccid)	*Arthrocnodax walkeriana* Felt (Dipt. Cecidomyiid)	Barnes (1930)
	Diadiplosis coccidivora Felt (Dipt. Cecidomyiid)	Rutherford (1914)
Pulvinaria psidii (Coccid)	*Exochomus nigro-maculatus* (Col. Coccinellid)	Green (1896)
Rhopalosiphum maidis Fitch. (Aphidid)	*Coccinella 6-maculata* F. (Col. Coccinellid)	New record
	Coccinella transversalis F. (Col. Coccinellid)	"
	Syrphus degrotus F. (Dipt. Syrphid)	"

Host Species	*Parasite or Predator*	*Authority*
Saissetia coffeae Walk. (Coccid) ..	*Cephaleta purpureiventris* Mots. (Hym. Pteromalid) ..	Ayyar (1925)
	Coccophagus flavescens How. (Hym. Aphelinid) ..	Green (1922)
	Diversinervus paradiscus Mots. (Hym. Encyrtid) ..	Compere (1931b)
	Scutellista cynaea Mots. (Hym. Pteromalid) ..	Ayyar (1925)
Saissetia hemisphaerica Trag. (Coccid)	*Aneristus ceroplastae* How. (Hym. Aphelinid) ..	Green (1904)
	Cephaleta brunneiventris (Hym. Pteromalid) ..	,,
	Cephaleta purpureiventris Mots. (Hym. Pteromalid) ..	,,
	Cirrospilus coccivorus Mots. (Hym. Eulophid) ..	,,
	Coccophagus orientalis How. (Hym. Aphelinid) ..	,,
	Encyrtus nietneri Mots. (Hym. Encyrtid) ..	,,
	Encytrus paradiscus Mots. (Hym. Encyrtid) ..	Green (1904)
	Scutellista cyanea Mots. (Hym. Pteromalid) ..	,,
Saissetia nigra Nietn. (Coccid) ..	*Cephaleta brunneiventris* (Hym. Pteromalid) ..	Green (1904)
	Cephaleta purpureiventris Mots. (Hym. Pteromalid)	
	Scutellista cyanea Mots. (Hym. Pteromalid) ..	Hutson (unpublished)
	Xiphodiplosis fulva Felt. (Dipt. Cecidomyiid) ..	Barnes (1930)
Saissetia oleae Bern. (Coccid) ..	*Coccophagus longifasciatus* How. (Hym. Aphelinid) ..	Smith and Compere (1928)
Serinetha augur F. .. (Coreid) ..	*Antilochus nigripes* Burm. (Hem. Pyrrhocorid) ..	Green (1909)
Scotinophora lurida Burm. (Pentatomid) ..	*Telenomus triptus* Nixon (Hym. Scelionid) ..	Fernando (1960)
Toxoptera aurantii Boy. (Aphidid) ..	*Scymnus flaviceps* Walk. (Col. Coccinellid) ..	New record
	Syrphus transversus Brun. (Dipt. Syrphid) ..	,,
	Eurytoma sp. (Hym. Eurytomid) ..	,,
Walkeriana kandynese (Coccid) ..	*Crytochaetum curtipenne* Knab (Dipt. Agromyzid) ..	Knab (1941)

Host Species	*Parasite or Predator*	*Authority*
Walkeriana sp. (Coccid) ..	*Anthrocnodax walkeriana* Felt (Dipt. Cecidomyiid) ..	Barnes (1930)
	Crypochaetum curtipenne Knab (Dipt. Agromyzid) ..	Rutherford (1914)
HYMENOPTERA:		
Eulimneria alkae E & S (Ichneumonid) ..	*Dibrachys* sp. (Hym. Pteromalid) ..	Chu and Hsia (1937)
	Gelis sp. (Hym. Ichneumonid) ..	,,
	Hemiteles hemipterus F. (Hym. Ichneumonid) ..	,,
	Homoporus sp. (Hym. Pteromalid) ..	,,
	Melittobia acasta Walk. (Hym. Eulphid) ..	,,
	Mormoniella vitrepennis Walk. (Hym. Pteromalid) ..	,,
	Pimpla roborator F. (Hym. Ichneumonid) ..	,,
Neurotoma nemoralis L. (Tenthredinid) ..	*Eulimneria alkae* E & S (Hym. Ichneumonid) ..	,,
LEPIDOPTERA:		
Achaea janata L. (Noctuid) ..	*Charops erythrogaster* Ashm. (Hym. Ichneumonid) ..	Beeson and Chatterjee (1935b)
Acherontia lachesis F. (Sphingid) ..	*Apanteles acherontiae* Cam. (Hym. Braconid) ..	,,
	Thrycolyga sorbillans Wd. (Dipt. Tachinid) ..	,,
Acrocerops ordinatella Meyr (Gracillariid) ..	*Sympiesis purpureus* Wtstn. (Hym. Eulophid) ..	Waterston (1915)
Amyna punctum F. (Phalaenid) ..	*Apanteles expulsus* Turner (Hym Braconid) ..	Wilkinson (1934)
	Zenillia frontalis Bar. (Dipt. Tachinid) ..	Hutson (unpublished)
Andraca bipunctata Walk (Bombycid) ..	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid) ..	Beeson and Chatterjee (1935c)
Antigastra catalaunalis Dup. (Pyraustid) ..	*Cremastus flavo-orbitalis* Cam. (Hym. Ichneumonid) ..	Chu and Hsia (1937)
Argyroploce illepida Butl. (Eucosmid) ..	*Cremastus flavo-orbitalis* Cam. (Hym. Ichneumonid) ..	Beeson and Chatterjee 1935b)
Argyroploce paragramma Meyr. (Eucosmid) ..	*Cremastus flavo-orbitalis* Cam. (Hym Ichneumonid) ..	,,
Asota caricae Bdv. (Hypsid) ..	*Apanteles heterusiae* Wlkn. (Hym. Braconid) ..	,,

Host Species	*Parasite or Predator*	*Authority*
Asura conferta Walk. (Arctiid) ..	*Apanteles cacao* Wlkn. (Hym. Braconid) ..	Wilkinson (1934)
	Apanteles nepitae Wlkn. (Hym. Braconid) ..	Wilkinson (1934)
Attacus ricini Boisd. (Saturnid) ..	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid) ..	Beeson and Chatterjee (1935c)
	Trichogramma evanescens Wstw. (Hym. Trichogrammid) ..	
Bombyx mori L. (Bombycid) ..	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid) ..	Beeson and Chatterjee (1935c)
Borolia venalba Mo. (Noctuid) ..	*Actia monticola* Mall. (Dipt. Tachinid) ..	*
	Actia tibialis R–D. (Dipt. Tachinid) ..	*
	Apanteles sp. (Hym. Braconid) ..	*
	Argylophylax bella Meig. (Dipt. Tachinid) ..	*
	Carcelia evolans Wied. (Dipt. Tachinid) ..	*
	Chaetospila elegans Westw. (Hym. Pteromalid) ..	*
	Halidaya luteicornis Bezzi. (Dipt. Tachinid) ..	*
Camena deva Mo. (Lycaenid) ..	*Apanteles pratapae* Ashm. (Hym. Braconid) ..	Wilkinson (1928a)
Caprina conchylalis Guen. (Pyraustid) ..	*Carcelia gnava* Meig. (Dipt. Techinid) ..	Bezzi (1922)
Chaliodes vitrea Hmps. (Paychid) ..	*Anastatoidea brachartonae* Gahan. (Hym. Eulophid) ..	King (1934a)
	Xanthopimpla punctata F. (Hym. Ichneumonid) ..	Chu and Hsia (1937)
Chilo simplex Butl. (Crambid) ..	*Crematus flavo-orbitalis* Cam. (Hym. Ichneumonid) ..	Chu and Hsia (1937)
	Phanerotoma hendecasisella Cram. (Hym. Braconid) ..	New record
	Xanthopimpla punctata F. (Hym. Ichneumonid) ..	Chu and Hsia (1937)
Olysia ambiguella Hb. (Phaloniid) ..	*Eulimneria alkae* E & S. (Hym. Ichneumonid) ..	"

Host Species	*Parasite or Predator*	*Authority*
Corcyra cephalonica Stt. (Galleriid)	*Microbracon hebetor* Say. (Hym. Braconid)	Glover and Chatterjee (1932)
	Trichogramma erosicornis Westw. (Hym. Trichogrammid)	King (1932)
	Trichogramma evanescens Westw. (Hym. Trichogrammid)	,,
Crocidolomia binotalis Zell. (Pyralid)	*Apanteles plutellae* Kurdj. (Hym. Braconid)	De Silva (1960)
	Sarcophaga peregrina R. (Dipt. Sarcophagid)	Baranoff (1934)
	Sturmia inconspicuoides Bar. (Dipt. Tachinid)	,,
	Winthemia diversa Malloch (Dipt. Tachinid)	,,
Cryptothelea crameri Westw. (Psychid)	*Mesostenus* sp. (Hym. Ichneumonid)	King (1934a)
	Sympiesis sp. (Hym. Eulophid)	,,
Cyclosia panthona Cram. (Zygaenid)	*Sturmia inconspicuoides* Bar. (Dipt. Tachinid)	,, *
Danais septentrionis Butl. (Lep. Nymphalid)	*Sturmia inconspicuoides* Bar. (Dipt. Tachinid)	,, *
Dasychira cerigoides Walk. (Lymantriid)	*Zenillia modicella* Wulp. (Dipt. Tachinid)	Beeson and Chatterjee (1935c)
Dasychira horsfieldi Strand. (Lymantriid)	*Henicospilus dasychirae* Cam. (Hym. Ichneumonid)	,, (1935b)
	Zenillia sumatrensis (Dipt. Tachinid)	,, (1935c)
Dasychira mendosa Hb. (Lymantriid)	*Enicospilus antankarus* Sauss. (Hym. Ichneumonid)	,, (1935b)
	Thrycolyga sorbillans Wd. (Dipt. Tachinid)	,, (1935c)
	Xanthopimpla punctata F. (Hym. Ichneumonid)	,, (1935b)
	Zenillia modicella Wulp. (Dipt. Tachinid)	,, (1935c)

Host Species	*Parasite or Predator*	*Authority*
Dasychira securis Hb. (Lymantriid)	*Microgaster carinicollis* Cam. (Hym. Braconid)	Wilkinson (1929)
Dasychira thwaitesi Mo. (Lymantriid)	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid)	Beeson and Chatterjee (1935c)
Diaphania indica Saund. (Pyralid)	*Apanteles taragamae* Vier. (Hym. Baconid)	Wilkinson (1931)
Dichocrocis nilusalis Wlk. (Pyralid)	*Bactromyiae franssoni* Bar. (Dipt. Tachinid)	Baranoff (1934)
	Microgaster psamae Wlkn. (Hym. Braconid)	,, *
Dichocrocis punctiferalis (Pyralid)	*Dolichurus* sp. (Hym. Ampulicid)	Baptist (1940)
	Phanerotoma hendecasisella Cam. (Hym. Braconid)	Baptist (1940)
	Xanthopimpla sp. (Hym. Icnhneumonid)	,,
Dichomerus evidentis Meyr. (Gelechiid)	*Phanerotoma hendecasisella* Cam. (Hym. Braconid)	Beeson and Chatterjee (1935a)
Earias fabia Stoll. (Phalaenid)	*Sturmia hutsoni* Bar. (Dipt. Tachinid)	Baranoff (1934)
Earias insulana Boisd. (Phalaenid)	*Phanerotoma hendecasisella* Cam. (Hym. Braconid)	Beeson and Chatterjee (1935a)
Ephestia cautella Walk. (Phycitid)	*Trichogramma erosicornis* Westw. (Hym. Trichogrammid)	King (1932)
Ephestia kuehniella Zell. (Phycitid)	*Microbracon hebetor* Say. (Hym. Braconid)	Glover and Chatterjee (1936)
	Trichogramma erosicornis Westw. (Hym. Trichogrammid)	King (1933)
	Trichogramma evanescens Westw. (Hym. Trichogrammid)	King (1934b)

Host Species	*Parasite or Predator*	*Authority*
Eublemma ambilis Mo. (Phalaenid)	*Aphrastobracon flavipennis* Ashm. (Hym. Braconid)	Beeson and Chatterjee (1935a)
	Microbracon greeni Ashn. (Hym. Braconid)	,,
Eublemma scitula Ram. (Phalaenid)	*Aphrastobracon flavipennis* Ashm. (Hym. Braconid)	,,
Euproctis flava Brem. (Lymantriid)	*Sturmia picta* Bar. (Dipt. Tachinid)	Baranoff (1934)
Euproctis fraterna Mo. (Lymantriid)	*Euplectus ceylonensis* How. (Hym. Eulophid)	Ayyar (1925)
Eupterote sp. (Eupterotid)	*Charops erythrogaster* Ashm. (Hym. Ichneumonid)	Beeson and Chatterjee (1935b)
Euzophera perticella Rag. (Phycitid)	*Crematus flavo-orbitalis* Cam. (Hym. Ichneumonid)	Chu and Hsia (1937)
Glacilaria theivora Wlsm. (Glacilarid)	*Angitia* sp. (Hym. Ichneumonid)	*
	Asympiesiella india Gir. (Hym. Eulophid)	*
Hedylepta diamenalis Guen. (Pyraustid)	*Bactromyia franssoni* Bar. (Dipt. Tachinid)	Baranoff (1934)
Heliothis armigera Hb. (Phalaenid)	*Apanteles rificrus* Hall. (Hym. Braconid)	Beeson and Chatterjee (1934a)
Hendecasis duplifasciella Hmpsn. (Endotrichid)	*Phanerotoma hendecasisella* Cam. (Hym. Braconid)	Wilkinson (1930)
Heterusiac cingula Mo. (Zygaenid)	*Apanteles heterusiae* Wlkn. (Hym. Braconid)	King (1934a)
	Exorista heterusiae Coq. (Dipt. Tachinid)	,,
Homona coffearia Nietn. (Tortricid)	*Antrocephatus* sp. (Hym. Chalcid)	King (1937)
	Apanteles sp. (Hym. Braconid)	*
	Bassus sp. (Hym. Braconid)	*

Host Species	*Parasite or Predator*	*Authority*
Homona coffearia Nietn., (Tortrieid)	*Brachymeria euploeae* Westw. (Hym. Chalcid) ..	*
	Elasmus homonae Ferr. (Hym. Elasmid) ..	Ferriere (1929)
	Leucospis sp. (Hym. Chalcid) ..	Jardine (1918a)
	Lissonata sp. (Hym. Chalcid) ..	,,
	Macrocentrus homonae Nixon (Hym. Braconcid) ..	King (1937)
	Mermis nigrescens Duj. (Nema : Mermithid) ..	Gadd (1939)
	Ophion bicarinatus (Hym. Ichneumonid) ..	Jardine (1918)
	Pleuroneurophion erythocerus Cameron (Hym. Ichneumonid) ..	,, (1918a)
	Phytodiaetus capuae Morl. (Hym. Ichneumonid) ..	,,
	Serphus sp. (Hy. Serphid) ..	,, (1918b)
	Stitictopisthus sp. (Hym. Ichneumonid) ..	*
	Tetrastichus sp. (Hym. Eulophid) ..	*
	Trichogramma australicum Gir. (Hym. Trichogrammid) ..	Jardine (1918b)
	Trichogramma erosicornis Westw. (Hym. Trichogrammid) ..	Light (1929)
	Trichogramma evanescens Westw. (Hym. Trichogrammid) ..	King (1935)
	Trichogramma nana Gir. (Hym. Trichogrammid) ..	,,
Hymenia recurvalis F. (Pyraustid) ..	*Cremastus flavo-orbitalis* Cam. (Hym. Ichneumonid) ..	Chu and Hsia (1937)
Hypsipila robusta Mo. (Phycitid) ..	*Apanteles rificrus* Hal. (Hym. Braconid) ..	Beeson and Chatterjee (1935a)

NATIVE PARASITES AND PREDATORS OF INSECT P STS IN CEYLON

Host Species	*Parasite or Predator*	*Authority*
Indarbela quadrinotata Walk. (Cossid) ..	*Zenilliac heterusiae* Coq. (Dipt. Tachinid) ..	Light (1928)
Laprosema annubilata Swinh. (Pyraustid) ..	*Bactromyia franssoni* Bar. (Dipt. Tachinid) ..	Baranoff (1934)
Laprosema diemenalis .. (Pyraustid)	*Bactromyia franssoni* Bar. (Dipt. Tachinid) ..	Hutson (1934)
	Frontina sp. (Dipt. Tachinid) ..	Hutson (1921)
	Trichospilus pupivora Ferr. (Hym. Eulophid) ..	Ferriere (1930)
Lenodora vittata Wlk. .. (Lasiocampid)	*Telenomus molcrchus* Nixon (Hym. Scelionid) ..	Hutson (unpublished)
Lygropia obrinusalis Walk. .. (Pyraustid)	*Torocca fasciata* Tns. (Dipt. Tachinid) ..	Beeson and Chatterjee (1935c)
Lymantria ampla Walk. .. (Lymantriid)	*Apanteles cacao* Wlkn. (Hym. Braconid) ..	Wilkinson (1934)
Macroplectra nararia Mo. .. (Limacodid)	*Autoplectrus taprobanes* Gadd (Hym. Eulophid) ..	Gadd, Fonseka and Ranaweera (1946)
	Canthecona robusta Dist. (Hem. Pentatomid) ..	King (1931)
	Euplectrus sp. (Hym. Eulophid) ..	Austin (1932)
	Fornicia ceylonica Wlkn. (Hym. Braconid) ..	Wilkinson (1928b)
	Goryphus variibalteatus Cam. (Hym. Ichneumonid) ..	Austin (1932)
	Hemiteles sp. (Hym. Ichneumonid) ..	Austin (1932)
	Platyplectrus natadae Ferr. (Hym. Eulophid) ..	Gadd, Fonseka and Ranaweera (1946)
	Rogas sp. (Hym. Braconid) ..	King (1931)
	Tetrastichus sp. (Hym. Eulophid) ..	Austin (1932)
Manatha albipes Mo. .. (Psychid)	*Elasmus ceylonicus* Ferr. (Hym. Elasmid) ..	Ferriere (1929)
	Elasmus hutsoni Ferr. (Hym. Elasmid) ..	"

Host Species	*Parasite or Predator*	*Authority*
Marasmia bilinealis Hmpsn. (Pyralid)	*Elasmus* sp. (Hym. Elasmid)	New record
Margaronia caesalis Wlk. (Pyralid)	*Phanerotoma hendecasisella* Cam. (Hym. Braconid)	Hutson (unpublished)
Margaronia indica (Pyralid)	*Apanteles taragamae* (Hym. Braconid)	,,
Maruca testulalis (Pyralid)	*Microdus* sp. (Hym. Braconid)	*
	Phanerotoma hendecasisella Cam. (Hym. Braconid)	*
Metanastria hyrtaca (Lasiocampid)	*Sturmia wainrighti* Bar. (Dipt. Tachinid)	Baranoff (1934)
	Thrycolyga sorbillans Wd. (Dipt. Tachinid))	Beeson and Chatterjee (1935c.)
Mocis frugalis F. (Phalaenid)	*Sarcophaga kempi* .. Senior White (Dipt. Sarcophagid)	Baranoff (1934)
Nacoleia annubilata Swinh (Pyralid)	*Bactromyia franssoni* Bar. (Dipt. Tachinid)	*
Narosa conspersa Wlk. (Limacodid)	*Canthecona robusta* Dist. (Hem. Pentatomid)	*
	Frontina sp. (Dipt. Tachinid)	Hutson (1921)
	Rogas sp. (Hym. Braconid)	King (1931)
Nephantis serinopa Meyr. (Lep. Tineid)	*Angitia* sp. (Hym. Ichneumonid)	Jayaratnam (1941a)
	Brachymeria nephantidis Gahan (Hym. Chalcid)	,,
	Eurytoma sp. (Hym. Eurytomid)	,,
	Fornicia ceylonica Wlk. (Hym. Braconid)	,,
	Perisierola nephantidis M. (Hym. Bethylid)	Jayaratnam (1941b)
	Stomatomyia bezziana Bar. (Dipt. Tachinid)	Jayaratnam (1941a)
	Trichospilus pupivora (Hym. Eulophid)	,,

NATIVE PARASITES AND PREDATORS OF INSECT PESTS IN CEYLON

Host Species	*Parasite or Predator*	*Authority*
Nemeta lalleana Mo. (Limacodid)	*Spinaria nigriceps* Cam. (Hym. Braconid)	Beeson and Chatterjee (1935a)
	Zenillia modicella Wulp. (Dipt. Tachinid)	Baranoff (1934)
Numonia pirivorella Mats. (Phycitid)	*Cremastus flavo-orbitalis* Cam. (Hym. Ichneumonid)	Chu and Hsia (1937)
Nygmia flava F. (Lymantriid)	*Euplectrus ceylonieus* How. (Hym. Eulophid)	Howard and Ashmead (1896)
	Sturmia picta Bar. (Dipt. Tachinid)	*
Ochyrotica concursa Wlsm. (Pterophorid)	*Apanteles bisulcata* Cam. (Hym. Braconid)	Wilkinson (1928a)
	Apanteles steganodactylae Cam. (Hym. Braconid)	,,
Ocinaria varians (Bombycid)	*Canthecona robusta* Dist. (Hem. Pentatomid)	Hutson (1930)
Olethreutes paragramma Meyr. (Olethreutid)	*Cremastus flavo-orbitalis* Cam. (Hym. Ichneumonid)	Chu and Hsia (1937)
Olethreutes schistaceana Sn. (Olethreutid)	*Xanthopimpla punctata* F. (Hym. Ichneumonid)	,,
Omides blackburni Butl. (Pyraustid)	*Cremastus flavo-orbitalis* Cam. (Hym. Ichneumonid)	,,
Orgyia turbata Butl. (Lymantriid)	*Zenillia modicella* Wulp. (Dipt. Tachinid)	Beeson and Chatterjee (1935c)
Orgyia postica (Lymantriid)	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid)	Hutson (1921)
Pammene theristis Meyr. (Eucosmid)	*Phanerotoma hendecasisella* Cam. (Hym. Braconid)	Beeson and Chatterjee (1935a)
Papilio aristolochiae F. (Papilionid)	*Apanteles aristolochiae* Wlkn. (Hym. Braconid)	Wilkinson (1928a)

Host Species	*Parasite or Predator*	*Authority*
Parasa lepida Cram. (Limacodid)	*Apanteles parasae* Rohw. (Hym. Braconid)	Austin (1931)
	Eurytoma monemae Rushka. (Hym. Eurytomid)	,,
	Podomyia setosa Dol. (Dipt. Tachinid)	King (1932)
	Rogas sp. (Hym. Braconid)	Austin (1931)
	Tachina munda Wd. (Dipt. Tachinid)	,,
Parnara guttata (Hesperiid)	*Actia monticola* Mall. (Dipt. Tachinid)	*
	Halidaya luteicornis Bezzi (Dipt. Tachinid)	*
	Xanthopimpla punctata F. (Hym. Ichneumonid)	Chu and Hsia (1937)
Parnara mathias F. (Hesperiid)	*Apanteles javensis* Rohw. (Hym. Braconid)	*
Parnara sp. (Hesperiid)	*Eupteromalus parnarae* Gahan (Hym. Pteromalid)	*
Phassus malabaricus Mo. (Hepialid)	*Rhaphis elongata* Wulp. (Dipt. Tachinid)	Beeson and Chatterjee (1935c)
	Thrycolyga psychidarum Bar. (Dipt. Tachinid)	Ferriere (1929)
Phyllocnistis citrella Staint (Gracilariid)	*Eurytoma* sp. (Hym. Eurytomid)	Hutson and Pinto (1934)
Platyptilip molopius Meyr. (Pterophorid)	*Apanteles paludicolae* Cam. (Hym. Braconid)	Wilkinson (1928a)
Plusia onchalcea F. (Noctuid)	*Copidosoma* sp. (Hym. Encyrtid)	New record
Plusia sp. (Noctuid)	*Apanteles* sp. (Hym. Braconid)	,,
	Apanteles ruficrus Hal. (Hym. Braconid)	*

NATIVE PARASITES AND PREDATORS OF INSECT PESTS IN CEYLON

Host Species	*Parasite or Predator*	*Authority*
Plutella maculipennis Curt. (Plutellid)	*Anilastus* sp. (Hym. Ichneumonid)	De Silva (1960)
	Apanteles plutellae Kurdj. (Hym. Braconid)	,,
Polychrosis botrana Schiff (Olthreutid)	*Eulimneria alkae* E & S. (Hym. Ichneumonid)	Chu and Hsia (1937)
Pratapa deva Mo. (Lycaenid)	*Apanteles pratapae* Ashm. (Hym. Braconid)	Wilkinson (1928a)
Prodinia litura F. (Noctuid)	*Actia monticola* Mall. (Dipt. Tachinid)	Hutson (unpublished)
	Apanteles rificrus Hal. (Hym. Braconid)	,,
	Canthecona robusta Dist. (Hem. Pentatomid)	,,
Psyche albipes Mo. (Psychid)	*Bactromyiae fransson*i Bar. (Dipt. Tachinid)	Baranoff (1934)
	Elasmus ceylonicus Femere (Hym. Elasmid)	Ferriere (1929)
	Elasmus hutsoni Femere (Hym. Elasmid)	,,
Psyche sp. (Psychid)	*Zenillia quadrimaculata* Bar. (Dipt. Tachinid)	Baranoff (1934)
Pyrausta machaeralis Walk. (Pyraustid)	*Phanerotoma hendecasisella* Cam. (Hym. Braconid)	Beeson and Chatterjee (1935a)
	Zenillia heterusiae Coq. (Dipt. Tachinid)	,,
Rabila frontalis Walk. (Phalaenid)	*Microbracon* sp. (Hym. Braconid)	Rao (1924)
Remigia frugalis F. (Noctuid)	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid)	Hutson (unpublished)
	Podomyia setosa Dol. (Dipt. Tachinid)	Austin (1931)

Host Species	*Parasite or Predator*	*Authority*
Schoenobius incertellus Walk. (Pyralid)	*Apanteles flavipes* Cameron (Hym. Braconid)	New record
	Apanteles schoenobii Wilk. (Hym. Braconid)	"
	Aprostocetus sp. (Hym. Eulophid)	"
	Isotima sp. (Hym. Ichneumonid)	"
	Shirakia schoenobii Vier. (Hym. Braconid)	"
	Telenomus dignus Gahan (Hym. scelionid)	Fernando (1954)
	Tetrastichus israeli Mani (Hym. Eulophid)	New record
	Tetrastichus schoenobii Ferriere (Hym. Eulophid)	Fernando (1954)
Sitotroga cerealella (Gelechid)	*Microbracon hebetor* Say (Hym. Braconid)	Glover and Chatterjee (1936)
	Trichogramma erosicornis Westw. (Hym. Trichogrammid)	King (1930)
Sphenarches caffer Zell. (Pterophorid)	*Apanteles plaudicolae* Cam. (Hym. Braconid)	*
Spodoptera mauritia Boisd. (Noctuid)	*Actia monticola* Mall. (Dipt. Tachinid)	*
	Apanteles antipoda Ashm. (Hym. Braconid)	Wilkinson (1928a)
	Apanteles rificrus Hal. (Hym. Braconid)	"
	Carcelia kockiana Towns (Dipt. Tachinid)	"
	Cincidela sex-punctata F. (Col. Cicidellid)	Hutson (1920)
	Cuphocera pyrogaster Rond. (Dipt. Tachinid)	*
	Halidaya luteicornis Bezzi (Dipt. Tachinid)	*
	Sarcophaga sp. (Dipt. Sarcophagid)	*
	Trichospilus pupivora Ferr. (Hym. Eulophid)	Ferriere (1930)

Host Species	*Parasite or Predator*	*Authority*
Stauropus alternus Wlk. (Notodontid)	*Apanteles taprobanae* Cam. (Hym. Braconid)	Beeson and Chatterjee (1935a)
	Carcelia gnava Mg. (Dipt. Tachinid)	Hutson (1921)
	Carcelia sumatrensis Bar (Dipt. Tachinid)	Baranoff (1934)
	Thrycloyga sorbillans Wd. (Dipt. Tachinid)	Hutson (1921)
	Zenillia sumatrensis Tns. (Dipt. Tachinid)	Beeson and Chatterjee (1935c)
Suana concolor Walk. (Lasiocampid)	*Sturmia wainwrighti* Bar. (Dipt. Tachinid)	Baranoff (1934)
Suastua gremius F. (Hesperiid)	*Carcelia sumatrensis* Towns (Dipt. Tachinid)	*
Sylepta derogata F. (Pyraustid)	*Xanthopimpla punctata* F. (Hym. Ichneumonid)	Chu and Hsia (1937)
	Apanteles sp. (Hym. Braconid)	New record
Tabidia aculealis Walk. (Pyraustid)	*Meteorus tabidiae* Wlk. (Hym. Braconid)	Wilkinson (1930)
Taragama dorsalis Wlk. (Lasiocampid)	*Sturmia atropivora* R-D. (Dipt. Tachinid)	*
Thiacidas postica Walk (Lymantriid)	*Thrycolyga sorbillans* Wd. (Dipt. Tachinid)	Beeson and Chatterjee (1935c)
	Zenillia modicella Wulp. (Dipt. Tachinid)	"
Thosea cervina Mo. (Limacodid)	*Canthecona robusta* Dist. (Hem. Pentatomid)	King (1931)
	Fornicia ceylonica Wlkn. (Hym. Braconid)	"
	Phorocera magna Bar. (Dipt. Tachinid)	Baranoff (1934)
	Podomyia setosa Dol. (Dipt. Tachinid)	King (1930)
	Rogas sp. (Hym. Braconid)	King (1931)
	Spoggosia grandis Macq. (Dipt. Tachinid)	Tubbs (1947)

Host Species	*Parasite or Predator*	*Authority*
Thosea cervina Mo. (Limacodid)	*Tachina munda* Wd. (Dipt. Tachinid)	Austin (1932)
	Trichospilus pupivora Ferr. (Hym. Eulophid)	Ferriere (1930)
Thosea recta Hmps. (Limacodid)	*Apanteles* sp. (Hym. Braconid)	King (1931)
	Fornicia ceylonica Wlkn. (Hym. Braconid)	"
	Rogas sp. (Hym. Braconid)	"
Tiracola plagiata Walk. (Phalaenid)	*Apanteles tiracolae* Ashm. (Hym. Braconid)	Wilkinson (1928a)
Trabala vishnu LeF. (Lasiocampid)	*Allocamptus sinuatus* Morl. (Hym. Ichneumonid)	Beeson and Chatterjee (1935b)
Trichoptilus paladum Zell.	*Apanteles paludicolae* Cam. (Hym. Braconid)	Wilkinson (1928a)
Zeuzera coffeal Nietn. (Cossid)	*Microbracon* sp. (Hym. Braconid)	Hutson (1932)
ORTHOPTERA :		
Hierodula sp. (Mantid)	*Iphiaulax* sp. (Hym. Braconid)	*
	Philomacroploea basimaculata Cam. (Hym. Braconid)	Cameron (1905)
Mantis sp. (Mantid)	*Podagrion greeni* Crawf. (Hym. Torymid)	Ayyar (1925)

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METEOROLOGICAL REPORT

Summary for April to June, 1961

INTERMONSOON weather with afternoon and evening thundershowers prevailed during April, but the rainfall was mainly scattered. From the 17th till the 20th and again towards the end of the month the thundershowers became fairly widespread, a few places receiving heavy falls. A temporary advance of south-west monsoonal conditions manifested itself between the 22nd and 24th, when morning showers were experienced in the south-western coastal regions with intermittent rain and thundershowers elsewhere in the south-west quarter. The monthly rainfall was heaviest in the south-western low country where several stations aggregated totals over 20 inches. Elsewhere in the south-west quarter the rainfall generally ranged between 5 and 15 inches. Outside the south-west quarter, the rainfall began to decrease gradually and was generally below 2 inches in the northern parts of the Island and in the Batticaloa and Hambantota Districts. A few stations recorded no rain at all. Rainfall was above normal in the south-western low-country and in the Monaragala-Bibile area, mainly above normal among the hills and below normal elsewhere. There were about fifteen daily falls over 5 inches, the highest being 8.44 inches on the 19th at Baddegama Estate, Baddegama.

The evening thundershowers of April continued for a few days into May. Signs of the south-west monsoon were noticeable from the 7th when scattered showers were experienced in the south-west quarter with occasional thundery activity in the east. The monsoon was established by about the middle of the month from when rain in the south-west quarter became more frequent and heavier with scattered evening thunder in the north-central and eastern parts. The monsoon was active between the 20th and 22nd when intermittent showers accompanied by thundershowers and winds reaching gale force were experienced along the south-western coastal belt. From the 23rd to 25th there was a marked improvement in the weather, due to dry north-westerly winds caused by a depression in the East Central Arabian Sea. This depression filled up by the 26th and the monsoon became active again with heavy rain and strong winds confined chiefly to the south-west quarter. The greater monthly totals of rainfall (of the order of 30 inches) were found along the south-western slopes of

the central hills and in the south-western lowlands. Outside the south-west quarter the monthly aggregates were generally below 5 inches. Least rainfall (totals below 2 inches) was experienced in the northern parts and at a few scattered stations in the east. A few stations had no rain at all. Rainfall was above normal in Batticaloa and Matara areas, and generally above normal in the northern half of the south-west quarter, while elsewhere it was below normal. There were about 25 daily falls over 5 inches, the highest being 8.40 inches on the 14th at Monrovia Group, Dodanduwa.

In June scattered light to moderate rain was experienced mainly in the south-west till the 6th, when the monsoon became active under the indirect influence of a depression in North Bay Bengal, and fairly widespread light to moderate rain was experienced on the 7th, 8th and 9th. Weather was mainly fair from the 10th till the 16th. Scattered light to moderate rain was experienced in the south-west from the 17th till the 25th. On the 26th the upper westerlies strengthened and active monsoon conditions prevailed till the end of the month. Occasional squalls were experienced along the south-west coastal areas. Several stations in the south quarter reported heavy falls on the 28th. The monthly rainfall was heaviest (totals over 20 inches) along the south-western slopes of the central hills. Elsewhere in the south-west quarter rainfall generally ranged between 5 and 15 inches. Outside the south-west quarter the rainfall decreased gradually and most stations on the eastern half of the island recorded falls under 2 inches. Over 30 stations had no rain at all. Rainfall was mainly above normal in the North-Western Province and the western half of North-Central Province and in the Hambantota, Monaragala, Matale, Mannar, Jaffna, Negombo and Colombo districts. Elsewhere it was below normal. There were 2 daily falls over 3 inches, 5.86 inches at Ratmalana and 5.10 inches at Dehiwala, both on the 28th.

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METEOROLOGICAL REPORT FOR THE QUARTER APRIL-JUNE, 1961

April

Station	Temperature				Humidity		Amount of Cloud	Rainfall			
	Mean Max	Offset	Mean Min	Offset	Day	Night (from Min)		Amount	Offset	Rain Days	Offset
	°		°		%	%		In	ches		
Anuradhapura	93·7	+2·0	75·2	+0·8	68	93	4·8	5·29	—1·14	14	+2
Badulla ..	85·1	+0·9	66·7	+0·5	75	95	6·0	7·54	+0·54	17	+1
Batticaloa ..	—	—	—	—	—	—	—	—	—	—	—
Colombo ..	87·6	—0·2	75·8	0	82	88	6·0	18·42	+9·35	21	+4
Diyatalawa ..	79·3	+1·3	60·5	—0·1	77	94	6·2	6·63	+0·09	20	+3
Galle ..	85·9	—0·2	76·3	—0·4	76	86	5·8	12·44	+3·73	15	—1
Hambantota ..	87·6	0	76·9	+0·6	76	86	5·6	1·78	—2·08	7	—3
Jaffna ..	—	—	80·8	+0·6	—	—	—	2·75	+0·52	5	0
Kandy ..	87·4	—0·3	69·7	—0·2	68	90	6·0	6·74	+0·74	17	—5
Kankesanturai	92·2	+0·7	79·3	+0·7	72	94	4·6	1·00	—0·54	4	+2
Kurunegala ..	92·4	+1·5	74·6	0	68	95	6·0	10·61	+0·70	13	—2
M'Illuppallama	93·3	+2·0	74·4	+0·5	67	88	5·0	8·33	+1·09	12	+2
Mannar ..	91·0	+0·6	78·9	+0·9	75	89	5·3	1·75	—1·67	8	+1
Nuwara Eliya..	72·4	+1·2	52·4	+2·5	78	91	6·2	10·61	+5·63	19	+4
Puttalam ..	90·3	+1·0	76·7	+0·6	69	84	6·1	7·68	+2·80	13	+3
Ratmalana ..	88·5	+0·5	76·3	+0·7	72	88	6·3	12·31	+1·74	18	—
Ratnapura ..	92·1	+0·9	73·8	+0·1	68	86	6·4	13·21	+1·64	22	+1
Talawakele ..	—	—	—	—	—	—	—	—	—	—	—
Trincomalee ..	91·7	+2·4	78·8	+1·1	71	86	4·8	2·83	+0·70	7	+1
Katunayake ..	88·2	—	75·5	—	78	93	4·2	16·62	—	19	—
Mullaitivu ..	91·9	—	76·7	—	70	91	3·9	0·51	—2·01	4	—
Vavuniya ..	93·5	—	74·9	—	66	90	5·3	3·94	—0·81	12	—

May

Station	Temperature				Humidity		Amount of Cloud	Rainfall			
	Mean Max	Offset	Mean Min	Offset	Day	Night (from Min)		Amount	Offset	Rain Days	Offset
	°		°		%	%		In	ches		
Anuradhapura ..	89·3	—1·6	75·8	—0·6	74	91	6·0	2·75	—0·79	8	+1
Badulla ..	85·4	—0·2	66·3	—0·1	73	95	6·2	4·11	—0·58	17	+5
Batticaloa ..	90·7	+0·3	77·5	—0·3	70	86	6·1	4·65	+2·86	7	+2
Colombo ..	86·8	—0·1	76·6	—1·1	81	91	7·0	20·10	+4·61	24	+1
Diyatalawa ..	77·6	—1·2	62·0	0	74	86	6·6	8·05	+1·99	14	0
Galle ..	84·4	—0·5	77·6	—0·5	78	84	6·0	16·62	+3·95	24	+3
Hambantota ..	86·2	—0·6	77·6	0	79	86	6·6	5·30	+1·03	17	+6
Jaffna ..	87·9	—0·2	81·9	+0·2	81	83	6·3	0·44	—1·56	2	—1
Kandy ..	83·4	—2·5	70·2	—0·4	72	87	7·0	11·09	+4·58	20	+9
Kankesanturai ..	91·4	—0·4	81·0	—0·4	73	85	6·1	0·82	—0·67	3	+1
Kurunegala ..	88·0	—1·1	75·9	—0·2	76	88	7·2	9·25	+1·70	18	+4
M'Illuppallama ..	89·1	—1·7	75·5	—0·9	70	86	6·6	2·65	—1·53	12	+7
Mannar ..	89·7	+0·2	80·3	—0·5	77	87	6·2	0·34	—1·45	2	—2
Nuwara Eliya ..	68·2	—2·1	55·2	+1·8	82	91	6·7	11·64	+3·17	21	+3
Puttalam ..	88·5	+0·1	78·7	—0·2	69	80	6·7	5·21	+1·44	11	+2
Ratmalana ..	87·4	+0·1	79·5	—1·5	74	86	7·0	17·99	+1·58	21	—
Ratnapura ..	89·0	0	74·2	—0·7	70	86	6·8	18·70	—2·21	25	+1
Talawakele ..	—	—	—	—	—	—	—	—	—	—	—
Trincomalee ..	93·1	+0·7	78·8	0	65	82	6·0	3·71	+0·48	7	+1
Katunayake ..	86·9	—	76·3	—	80	91	6·6	13·75	—	26	—
Mullaitivu ..	93·3	—	77·3	—	67	86	5·8	4·79	+2·91	7	—
Vavuniya ..	92·1	—	76·2	—	66	86	6·2	0·88	—2·88	8	—